

AUSTRALIAN RESEARCH COUNCIL
SPECIAL RESEARCH INITIATIVES
APPLICATION FORM FOR FUNDING IN 2005 ONLY



Note: you must read the *Special Research Initiatives - Funding Rules for funding commencing in 2005, ARC e-Research; invitation for Funding Proposals under ARC SRI and the SRI instructions to applicants* before filling out this form.

Initiative ID: SR0567334

| | |
|--|-----------|
| Total number of sheets contained in this application | 30 |
|--|-----------|

Information on this form is collected in order to make recommendations to the Minister on the allocation of financial assistance under the Australian Research Council Act 2001 and for post award-reporting. The information collected may be passed to assessors for the purposes of obtaining a peer review assessment of the application. It may also be passed to the National Health and Medical Research Council, the National Occupational Health and Safety Commission, the Department of Foreign Affairs and Trade, the Department of Industry, Tourism and Resources, the Department of the Environment and Heritage, the Department of Education, Science and Training, the Department of Agriculture, Fisheries and Forestry and the Department of Veterans' Affairs for the purpose of checking eligibility. In other instances, information on this form can be disclosed without your consent where authorised or required by law.

PART A—ADMINISTRATIVE SUMMARY

A1 ORGANISATION TO ADMINISTER GRANT

Name

A2 INITIATIVE TITLE

(Provide a descriptive title of no more than 20 words)

A3 PARTICIPANT SUMMARY

Personnel who will be responsible for the conduct of the initiative.

Notes: Participant details are sought in Part B.

The first named person must be from the administering organisation.

| Person number | Family name | Initials | Organisation | Role |
|---------------|-------------|----------|-------------------------------------|------|
| 1 | Drennan | J | The University of Queensland | CI |
| 2 | Hunter | JL | DSTC Pty Ltd | CI |
| 3 | Ringer | SP | The University of Sydney | CI |
| 4 | Munroe | PR | The University of New South Wales | CI |
| 5 | Griffin | BJ | The University of Western Australia | CI |
| 6 | Prawer | S | The University of Melbourne | CI |

A4 SUMMARY DESCRIPTIONS

A4.1 INITIATIVE SUMMARY

In no more than 750 characters (approx 100 words) of plain language, summarise aims, significance and expected outcomes.

The Nanostructural Analysis Network Organization (NANO) is an Australian Major National Research Facility that provides access to a grid of advanced microscopic instruments for the nanostructural analysis of both physical materials and biological systems. The aim of this initiative is to provide the NANO community with a set of common, interoperable tools and services to enable more efficient, cost-effective storage, management, analysis and sharing of generated microscopic images, video and analytical data. The significance of the proposed middleware is that it will improve collaboration and reduce duplication across many disciplines, through a shareable, distributed national scientific image/video database.

A4.2 Summary of National/Community Benefit (For Publicity Purposes)

In no more than 750 characters (approx 100 words) of plain language, summarise the national/community benefits that are expected to arise from the research.

The development of a distributed national archive of nanostructural images and videos, generated by research, government and industry organizations using Australia's premier microscopic instruments, would encourage greater sharing, re-use and collaboration across many disciplines and organizations. By enabling long term accessibility, sharing and re-use of microscopic imagery, the project will add value to existing research investments, shorten R&D cycles, maximize potential social and economic benefits in materials science, nanotechnologies and biomedical domains and improve our competitiveness in the knowledge economy, across many disciplines.

A5 CLASSIFICATIONS AND OTHER STATISTICAL INFORMATION

A5.1 Keywords

| |
|---------------------------|
| Nanostructural Analysis |
| Distributed Image Archive |
| National Network |

| |
|----------------|
| Telemicroscopy |
| Grid |
| |

A5.2 Research classifications

| Research Fields, Courses and Disciplines (RFCD) | % |
|---|----|
| 280302 | 40 |
| 280106 | 30 |
| 280203 | 30 |

| Socio-Economic Objective (SEO) | % |
|--------------------------------|----|
| 671401 | 40 |
| 700103 | 30 |
| 780102 | 30 |

A5.3 If the proposed research involves international collaboration, please specify country/ies.

| | | |
|-------|--------|--------------|
| Japan | USA | South Africa |
| UK | France | Singapore |
| | | |
| | | |

A5.4 National Research Priorities

| | |
|--|---|
| National Research Priority Frontier Technologies for Building and Transforming Australian Industries | Priority Goals Frontier technologies, Advanced materials, Smart information use |
|--|---|

A6 ADDITIONAL DETAILS

A6.1 Have any participants on this application submitted an application with similar aims to any other agency? Yes No

If Yes, please provide details.

A6.2 Do you wish this application to be assessed as an initiative of benefit to regional or rural community/ies? Yes No

A7 CERTIFICATION

The administering organisation must obtain the required signature(s) before submitting this application to the ARC.

A7.1 Certification by the Deputy/Pro Vice-Chancellor (Research) or delegate, or equivalent officer, in the administering organisation

I certify that—

I am prepared to have the initiative carried out in my organisation under the circumstances set out by the applicant(s).

To the best of my knowledge all details on this application form are true and complete and that no information specifically relating to applicant track or publication records is false or misleading.

The amount of time that the participant/s will be devoting to the initiative is appropriate to existing workloads.

This organisation supports this application and if successful will provide basic infrastructure and any items listed in the budget for the initiative.

All funds for this initiative will be spent only for the purpose for which they were provided.

The initiative can be accommodated within the general facilities in this organisation, and sufficient working and office space is available for any proposed additional staff.

I have obtained the agreement of other organisations involved to submit this application and to provide any agreed support.

The first named participant has obtained the agreement of all participants to submit this application.

I consent, on behalf of the participants, to this application being referred for peer review to persons who will remain anonymous.

To the best of my knowledge, the Privacy Notice appearing at the top of this Application Form has been drawn to the attention of all the participants whose personal information has been collected by this application.

I understand that it is an offence under the *Criminal Code Act 1995* to provide false or misleading information.

Signature of DVC/PVC(R) or delegate or equivalent officer
(in black ink)

Name and Title (please print)

Date

PART B—PERSONNEL

Part B must be completed for each participant listed in Part A3

B1 PERSON NUMBER

1

B2 ABBREVIATED DETAILS

| | |
|---------|--------|
| GAMS ID | A02104 |
|---------|--------|

| | | | | | |
|-------------------------|---|-------------|--|------|----|
| Family name | Drennan | | | Role | CI |
| First name | John | Second name | | | |
| Title | Prof | | | | |
| Department/school/other | Centre for Microscopy and Microanalysis | | | | |
| Organisation | The University of Queensland | | | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|---|-------|-----|----------|------|---------|-----------|
| Department/school/other | Centre for Microscopy and Microanalysis | | | | | | |
| Organisation | The University of Queensland | | | | | | |
| Postal address line 1 | | | | | | | |
| Postal address line 2 | | | | | | | |
| Locality | Brisbane | State | QLD | Postcode | 4072 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No **X**

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No **X**

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes No **X**

If Yes, please name the Centre

B1 PERSON NUMBER

2

B2 ABBREVIATED DETAILS

| | |
|---------|--------|
| GAMS ID | R92347 |
|---------|--------|

| | | | | | |
|-------------------------|--|-------------|--------|------|----|
| Family name | Hunter | | | Role | CI |
| First name | Jane | Second name | Louise | | |
| Title | Dr | | | | |
| Department/school/other | CRC for Enterprise Distributed Systems Technology (DSTC) | | | | |
| Organisation | DSTC Pty Ltd | | | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|--|-------|-----|----------|------|---------|-----------|
| Department/school/other | CRC for Enterprise Distributed Systems Technology (DSTC) | | | | | | |
| Organisation | DSTC Pty Ltd | | | | | | |
| Postal address line 1 | University of Queensland | | | | | | |
| Postal address line 2 | Level 7, GP South | | | | | | |
| Locality | Queensland | State | QLD | Postcode | 4072 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No X

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No X

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes X No

If Yes, please name the Centre

CRC for Enterprise Distributed Systems Technology

B1 PERSON NUMBER**3****B2 ABBREVIATED DETAILS**

| | |
|---------|---------------|
| GAMS ID | S89605 |
|---------|---------------|

| | | | | | |
|-------------------------|--|-------------|-------|------|----|
| Family name | Ringer | | | Role | CI |
| First name | Simon | Second name | Peter | | |
| Title | A/Prof | | | | |
| Department/school/other | Australian Key Centre for Microscopy and Microanalysis | | | | |
| Organisation | The University of Sydney | | | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|--|-------|-----|----------|------|---------|-----------|
| Department/school/other | Australian Key Centre for Microscopy and Microanalysis | | | | | | |
| Organisation | The University of Sydney | | | | | | |
| Postal address line 1 | | | | | | | |
| Postal address line 2 | | | | | | | |
| Locality | Sydney | State | NSW | Postcode | 2006 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No X

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No X

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes No X

If Yes, please name the Centre

B1 PERSON NUMBER

4

B2 ABBREVIATED DETAILS

| | |
|---------|---------------|
| GAMS ID | B23865 |
|---------|---------------|

| | | | |
|-------------------------|-----------------------------------|-------------|---------|
| Family name | Munroe | Role | CI |
| First name | Paul | Second name | Richard |
| Title | Prof | | |
| Department/school/other | Electron Microscope Unit | | |
| Organisation | The University of New South Wales | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|-----------------------------------|-------|-----|----------|------|---------|-----------|
| Department/school/other | Electron Microscope Unit | | | | | | |
| Organisation | The University of New South Wales | | | | | | |
| Postal address line 1 | | | | | | | |
| Postal address line 2 | | | | | | | |
| Locality | Sydney | State | NSW | Postcode | 2052 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No X

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No X

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes No X

If Yes, please name the Centre

B1 PERSON NUMBER

5

B2 ABBREVIATED DETAILS

| | |
|---------|--------|
| GAMS ID | X00459 |
|---------|--------|

| | | | | | |
|-------------------------|-------------------------------------|-------------|------|------|----|
| Family name | Griffin | | | Role | CI |
| First name | Brendan | Second name | John | | |
| Title | A/Prof | | | | |
| Department/school/other | Microscopy & Microanalysis | | | | |
| Organisation | The University of Western Australia | | | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|---------------------------------------|-------|------|----------|------|---------|-----------|
| Department/school/other | Microscopy & Microanalysis | | | | | | |
| Organisation | The University of Western Australia | | | | | | |
| Postal address line 1 | Centre for Microscopy & Microanalysis | | | | | | |
| Postal address line 2 | 35 Stirling Highway | | | | | | |
| Locality | Crawley | State | W.A. | Postcode | 6009 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No X

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No X

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes No X

If Yes, please name the Centre

B1 PERSON NUMBER

6

B2 ABBREVIATED DETAILS

| | |
|---------|--------|
| GAMS ID | I00107 |
|---------|--------|

| | | | | | |
|-------------------------|-----------------------------|-------------|--|------|----|
| Family name | Praver | | | Role | CI |
| First name | Steven | Second name | | | |
| Title | Prof | | | | |
| Department/school/other | School of Physics | | | | |
| Organisation | The University of Melbourne | | | | |

B3 POSTAL ADDRESS

| | | | | | | | |
|-------------------------|-----------------------------|-------|-----|----------|------|---------|-----------|
| Department/school/other | School of Physics | | | | | | |
| Organisation | The University of Melbourne | | | | | | |
| Postal address line 1 | | | | | | | |
| Postal address line 2 | | | | | | | |
| Locality | Parkville | State | VIC | Postcode | 3010 | Country | Australia |

B4 MEMBERSHIPS/ASSOCIATIONS

B4.1 Are you a current member of the ARC or its advisory committees? Yes No X

B4.2 Are any of your relatives or close social/professional associates current members of the ARC or its advisory committees? Yes No X

If Yes, please provide name(s) of the ARC member(s)

B4.3 Are you associated with a Commonwealth Government funded Centre? Yes No X

If Yes, please name the Centre

PART C—INITIATIVE COST

| |
|--|
| Costs are quoted exclusive of the GST. |
|--|

C1 BUDGET DETAILS FOR 2005

| Column 1 | COSTING | | | | | |
|--|---------------|--------------|-------------------|--------------|----------|---------------|
| | 2 | 3 | 4 | | 5 | 6 |
| Source of funds | ARC | Admin Org | Industry Partners | | Other | Total |
| | | | Cash | In-kind | | |
| DIRECT COSTS | | | | | | |
| Personnel (Salaries + On-costs) | | | | | | |
| Chief Investigator | 25704 | 0 | 0 | 0 | 0 | 25704 |
| Technical assistance | 77831 | 0 | 0 | 0 | 0 | 77831 |
| Initiative personnel | 0 | 0 | 0 | 10000 | 0 | 10000 |
| Total Personnel (a) | 103535 | 0 | 0 | 10000 | 0 | 113535 |
| Travel | | | | | | |
| Workshop activities | 13713 | 0 | 0 | 0 | 0 | 13713 |
| ICT short term visits. | 5400 | 0 | 0 | 0 | 0 | 5400 |
| Post-funding workshop | 3100 | 0 | 0 | 0 | 0 | 3100 |
| Total Travel (b) | 22213 | 0 | 0 | 0 | 0 | 22213 |
| Other | | | | | | |
| Software | 0 | 0 | 0 | 10000 | 0 | 10000 |
| Server for storing metadata and data fro pilot project | 0 | 30000 | 0 | 0 | 0 | 30000 |
| Administrative | 0 | 10000 | 0 | 0 | 0 | 10000 |
| Total Other (c) | 0 | 40000 | 0 | 10000 | 0 | 50000 |
| TOTAL COSTS (d) | 125748 | 40000 | 0 | 20000 | 0 | 185748 |

C2 JUSTIFICATION OF FUNDING REQUESTED FROM THE ARC

Personnel (Salaries + On-costs)

The plan is to use the funding to employ two personnel for the initiative:

Chief Investigator – this will fund 20% of Dr Hunter's time so she can provide the technical management and systems design for the proposed middleware and supervise the programmer.

(Apart from Dr Hunter, all of the other CIs will contribute (approx. 5-10% of their time) to this initiative, through their existing roles as directors of the NANO MNRF)

0.2 for 12 months at Professorial Level, Step1 $\$102,000 + 26\% = \$128,520 \times 0.2 = \$25,704$

Dr Hunter will be responsible for managing the overall project and directly supervising the programmer. She will also be responsible for carrying out: the requirements analysis; analysis of existing relevant technologies, standards and projects; the overall architectural design of the system; semantic augmentation of the Metadata Catalog and the SRB and adapting the research in response to new technological advances or emerging standards. She will also liaise with collaborators, arrange access to external research facilities and be responsible for managing the analysis and communication of results. As an internationally recognized expert in multimedia digital libraries, semantic grid technologies and knowledge management for eScience, Dr Hunter is the ideal person to fill this role.

Computer programmer to develop software infrastructure and distributed database fulltime for 12 months at Lecturer B step 2 = $\$61,771 + 26\% = \$77,831.46$

The programmer will be responsible for developing and integrating the metadata schemas, metadata generation tools, the annotation tools, the inferencing engine and the common search interface across the distributed database. The programmer will also need to work closely with JEOL to understand and program the interface between the instruments' image capture software and the database.

Travel:

Workshop activities:

The plan is to hold an international workshop in Brisbane mid-way through the project. It is crucial for Australia's research effort to keep abreast of international developments, and hosting a high profile workshop of the kind proposed here will bring experts together and demonstrate the leading-edge position of Australian research in this area.

Travel costs for participants to attend the international workshop on grid-enabled scientific image and data repositories to be held in Brisbane:

London x 1: \$2637; East coast USA x 1: \$2376; Sydney x 2, \$500 each = \$1000; Melbourne x 1 = \$500; Perth x 1 = \$1200. Total = \$ 7713

Conference venue: 3 days @ \$1000; plus incidental running costs \$300 = \$3300;

Accommodation, \$150 night x 6 x 3 nights participants = \$2700.

Total international workshop costs = \$13,713

ICT short term visits. Meetings of working group: Brisbane, Sydney, Melbourne, Perth - 2 meetings x 3 people @ \$500 per ticket (\$3,000), 2 meetings Perth - 1 person @ \$1200 per ticket (\$2,400). **Total = \$5,400**

Post-funding workshop in Canberra:

Airfares: 2 x Brisbane-Canberra, \$800; 2 x Sydney-Canberra, \$500. Total = \$1,300

Accommodation in Canberra 3 nights x 4 @ \$150 per night. Total = \$1,800

Total = \$3,100

C3 JUSTIFICATION OF INDUSTRY PARTNER AND OTHER NON-ARC CONTRIBUTIONS

The administering organization, the Centre for Microscopy and Microanalysis at the University of Queensland will provide significant support to this initiative through the following in-kind contributions:

- \$30,000 has been allocated for the purchase of a high-performance server for storing the metadata, scientific images and data associated with the pilot project. Initial investigations have indicated that an SGI Altix 350 server with 2 processors, 2 x Itanium2 1.5GHz, 16 GB memory and 2x73GB disks, would be in this price-range and suitable for the proposed application.. This system would also integrate seamlessly with the existing QPSF, ac3 and VPAC computing and storage infrastructure;
- \$10,000 cash to be used for administration (clerical, copying, accounting etc) plus additional software licenses (e.g., MATLAB).

The primary industry partner will be JEOL (Australasia Pty Ltd). JEOL is an international company with more than 50 years expertise in developing instruments used to advance scientific research and technology and the leading supplier of scientific instrumentation to NANO. Instruments developed and supported by JEOL include: scanning electron microscopes (SEMs), transmission electron microscopes (TEMs), scanning probe microscopes (SPMs), [mass spectrometers](#), [NMR spectrometers](#), and [semiconductor tools](#) for scientific and industrial purposes — uses range from routine analysis of organic and inorganic specimens to breakthroughs in nanotechnological development. Close collaboration with JEOL will be necessary in order to understand the intricacies of and interfaces to the image acquisition and manipulation software and hardware that accompanies each instrument. JEOL is keen to be involved in this initiative in order to maximize the interoperability and standards-compliance of their software.

JEOL Australasia Ltd have committed to contributing the following inkind resources to this initiative:

- 10 days of Vitaly Lozbin's time (@ \$1,000/day) - this will be to provide technical assistance to the programmer and to attend meetings and the workshop;
- Software associated with JEOL's scientific instruments that enables:
 - digitization and extraction of images and associative analytical data;
 - recording of metadata associated with the instrument and instrument settings;
 - an application programming interface (API) between the instrumental software and hardware and external systems, such as the database.

PART D—INITIATIVE DESCRIPTION

D1 INITIATIVE TITLE

“A Grid-enabled National Archive of Nanostructural Imagery (GRANI)”

D2 AIMS, SIGNIFICANCE AND BACKGROUND

AIMS

The Nanostructural Analysis Network Organization (NANO) is an Australian Major National Research Facility (MNRF) that provides coordinated access to a grid of advanced instruments for the nanostructural analysis of both physical materials and biological systems. Distributed across five nodes (the Australian Key Centre for Microscopy & Microanalysis of the University of Sydney, the Electron Microscope Unit of the University of New South Wales, the Centres for Microscopy and Microanalysis at the University of Queensland and the University of Western Australia and the Microanalytical Research Centre at the University of Melbourne), NANO effectively unites the major university-based microscopy and microanalysis centres - that until recently, operated independently within their own institutions. NANO also networks the most comprehensive range of high-level instruments in the region - ranging from advanced light systems through scanning electron microscopes to instruments capable of analysing and visualising single atoms. In addition, NANO is implementing a telemicroscopy network that connects the instruments and users across the nodes via the high speed GrangeNet network, enabling real-time, interactive, remote access to instruments by distributed groups of collaborating scientists.

Combining Australia’s peak microanalysis centres through the MNRF mechanism has created a more efficient, cost-effective and robust platform for nanotechnology-related research in Australia. It has established the required instrumental and network infrastructure to enable Australia to compete in this exciting and rapidly expanding field. The next step required to fully realize the potential socio-economic benefits of NANO is to also provide the distributed data management infrastructure on which more advanced knowledge mining services can be developed.

The increasingly sophisticated capabilities of scientific instruments have driven parallel advances in data acquisition technologies and accelerated the resolution and speed at which scientists can collect 2D, 3D and time-dependent image and analytical data. The NANO community in particular generates massive amounts of image data (and to a lesser extent video and spectrometry data) on the macro-, micro- and nano-scale levels that has the potential for yielding a wealth of information on everything from nano-materials (such as carbon nanotubes or silicon crystals) to new nano-scale protein-based drugs.

Unfortunately the data handling capabilities of NANO have not kept pace with the sophistication of the scientific instruments or users’ needs or expectations. There are currently no data management standards across the nodes and no uniform means of storing, indexing and distributing images and data to the clients that currently use the system. Most researchers and users only have short-term access to a local personal folder of a restricted size, in which they must store their microscopy images and associated datasets. Files are automatically deleted after a certain set period or when users exceed their hard disk space allocation. Users save their images and data to CDs and DVDs which sit on shelves in their offices. There is little or no metadata attached to the captured content. Massive images and datasets are transferred across nodes as email attachments or via ftp. Currently storing, retrieving and managing the captured images, video and data is a manual, time-consuming and costly process for both users and managers. There is great demand for efficient interoperable software tools for indexing, storing, managing, manipulating, analysing and sharing the large volumes of image, video and analytical data generated across the NANO nodes. A coordinated, standardized approach to data management would reduce the costs of research, enable greater sharing of results, reduce duplication, and maximize the potential knowledge and socio-economic benefits derivable from the captured images, video and data.

The primary aim of this initiative is to provide the NANO community with a Grid-aware middleware system that enables the collaborative management and analysis of images and data on a massive scale, by leveraging distributed software components coupled with networked computation and storage platforms.

This initiative will be the first step in providing the NANO community with a secure, standardized and robust web interface to:

- the instruments, computing power, storage and expertise that comprise NANO;
- a common set of interoperable tools and services for indexing, archiving, searching, retrieving, analysing and sharing microscopic images, video and analytical data;
- a secure distributed archive of shareable, re-usable scientific images, video and data.

More specifically the project aims are to provide the multidisciplinary users of the NANO MNRF with a common set of cost-effective and efficient services and tools to enable:

- Indexing and storage of microscopic images, video and spectrometry data, in agreed high quality standardized formats within a distributed database (across the 5 NANO nodes);
- Streamlined (automated where possible) capture of precise metadata and provenance data associated with each image, video or data file (e.g., creator, date, instrument, instrument location, instrument settings, origin of specimen, specimen preparation details etc);
- The association of additional, contextual data with each image (e.g., associated experimental, manufacturing, performance or historical data);
- A secure, web-based search, browse and retrieval interface – that enables seamless but controlled access to images/video and associated data stored on servers located at nodes on the NANO network – enabling different levels of access and controlled sharing of images amongst trusted members of collaborative teams;
- Real-time collaborative sharing and browsing of image collections by geographically distributed groups of users;
- Annotation tools that enable scientific teams to collaboratively attach notes/interpretations to images, video and datasets for later retrieval or teaching purposes;
- Easy online access to and invocation of relevant, discipline-specific and generic image analysis tools and services;
- Re-use of images and data in online learning objects for teaching purposes and scholarly publications;
- Methods for defining and enforcing access constraints associated with the images, video and data (e.g., selective sharing with trusted colleagues, tracking and controlling usage through watermarking and copyright management).

The system will be developed on top of the APAC high performance computing Grid (in particular QPSF, ac3 and VPAC) and the GrangeNet broadband network infrastructure established within Australia. This will ensure that the large image datasets that are characteristic of nanostructural analysis, can be quickly and easily discovered, retrieved, analysed, distributed and viewed by geographically-distributed groups of scientists, collaborating across high speed networks in real-time – without the problems associated with bandwidth bottlenecks or limited processing power.

The plan is to use the Special Research Initiative (SRI) funding to: carry out a detailed requirements analysis across the NANO nodes; survey existing technologies; design the system architecture; and implement a pilot project across two nodes to evaluate the technologies and demonstrate feasibility.

This initiative represents the first step in a longer term strategic plan which is to provide the NANO community with a secure, standardized but extensible data management platform on which more advanced knowledge mining capabilities can be developed in the future.

SIGNIFICANCE

The fundamental aim underpinning the establishment of NANO is to promote a national coordinated strategy to the development of advanced nanostructural analysis infrastructure for Australian research and industry – thus avoiding unnecessary wastage through duplication of existing facilities and consolidating and expanding specialised expertise in innovative nanotechnology and biotechnology through collaboration and sharing of results, knowledge, ideas and techniques.

The significance of this project is that the proposed middleware will facilitate cost-effective, efficient access to and management of the facilities, services and data of NANO, and improve

collaboration, teaching and knowledge diffusion through a shareable national scientific image/video database.

The potential impact of the initiative is huge, given the range of industries and organizations that use NANO facilities. Each of the five NANO nodes has approx 300 clients covering an expanding variety of disciplines and applications. Materials technology at the nano-scale covers systems from quantum computing through to the development of novel catalysts and new sun-screen materials. Applications are not just confined to the physical sciences community but include developments in drug delivery, bio-scaffolding and the development of tomographic images of cellular components. Major industry clients of NANO range from multinationals to SMEs and startups including: BHP Billiton, Alcoa, Comalco, CSIRO Exploration and Mining, Advanced Nano Technology Limited, Peregrine Semiconductor, Ceramic Fuel Cells Limited, Very Small Particle Company, KAKEN and a number of biotech companies (e.g., Eiffel Technologies, Sirtex Medical).

NANO is also currently implementing a telepresence microscopy network that will provide partners, current and future users with a web portal to a selection of instruments and a single common booking system. Researchers are planning to conduct research projects that involve remote access to multiple microscopy, microanalysis and nanostructural analysis instruments and expertise across the NANO nodes. To achieve this, users not only require barrierless access to the NANO-MNRF resources but they also require methods for capturing, retrieving, sharing, annotating and re-using the results of such sessions. A secure, web-based interface to NANO's resources and services as well as the image, video and scientific data generated from their use, will contribute significantly to improving the quality of Australia's research capacity across many communities. Time, money and effort that is wasted on finding, negotiating access to, travelling to and managing NANO resources can be better spent on a more systematic, collaborative approach that focuses on scientific problem solving through better information management and knowledge mining.

But significant problems face the service providers, who want to provide seamless access to networked instruments, computing facilities and data stores, to a wide variety of users and disciplines. Below is a list of some of the most significant issues facing the managers of the NANO network:

- Preservation/archival issues – significant amounts of data/images has been acquired from high performance NANO instruments over the past ten years. Much of this data has been lost or is inaccessible, hidden in localized, proprietary databases, sitting on office shelves or in danger of becoming inaccessible, because of media, software or hardware obsolescence;
- The proprietary nature of instrumental software and hardware – the microscopes, probes, spectrometers and semi-conductor equipment used by NANO (and supplied by companies such as JEOL) are often supplied with specific hardware and software that enables the image acquisition and handling. Methods are needed to enhance the interoperability of these platforms to ensure compliance to open standards and to enable easy integration across systems and seamless interfaces to distributed databases.
- High performance computing – distributed computing and parallel processing will be required to rapidly segment, analyse, process, enhance and transform the (optical, spectral, 3D) images, video and datasets generated by the instruments. In particular more and more microscopes support the extraction of 2D cross-sectional data which can be combined to generate 3D nano-structural reconstructions. This is particularly slow and computationally intensive and could benefit significantly from compute grids.
- Complex, multidimensional, heterogeneous data – NANO instruments generate an array of image, video and data types ranging from 2D to 3D images and spectrometry data, animations and chemical analyses. Tools are needed to support, index, search, retrieve and present all of these different formats.
- Distributed Experiments – experimental data is captured at different stages by different community participants using different instruments. Metadata workflows are required to enable the capture of distributed heterogeneous data and for integrating and assimilating it.

- Trust/Security - Authentication and role-based access tools are required to control access rights to distributed databases that contain highly sensitive, confidential company-specific data or IP associated with academic research.
- Context Awareness, Situation Sensitivity, Personalization - different users have different requirements, levels of knowledge, interests – search results need to match user profile/requirements. Image/video quality should adapt dynamically to match bandwidth availability, user needs and client capabilities.
- Scalability – a single digitized microscopy image can reach up to several tens of Gigabytes in size and a research study many require access to hundreds of such images. 3D datasets in particular are massive and increasingly common. Architectural and system designs need to support data management on such a massive scale.
- Sustainability – the costs associated with managing ever-increasing amounts of data, images and video are constantly increasing. New business models are needed to share and reduce these costs. One possibility is for the NANO nodes to charge industry clients for more advanced image/data management and archival services.

This initiative may not generate solutions to all of the problems listed above but it will certainly contribute to mitigating the severity of many of these challenging issues.

BACKGROUND

The aim is to develop a Grid-based middleware system that enables the storage, retrieval, management and analysis of images, video and data generated by NANO on a massive scale, leveraging distributed software components coupled with interconnected computation and storage platforms. The architecture will be designed to support the wide range of data types, users and applications encountered within the NANO nodes.

The plan is to leverage pre-existing tools and services and proven approaches in constructing the common set of tools and services and the distributed image archive. Pre-existing approaches or standards that will be analysed and considered for (full or partial) adoption include:

- GridPACS - A Grid-enabled System for Management and Analysis of Large Image Datasets plus Datacutter, STORM and Mobius (http://bmi.osu.edu/areas_and_projects/datacutter.cfm)
- SIDB – Scientific Image Database – open-source software for archiving 2D and 3D microscopy images (<http://sidb.sourceforge.net/>);
- Image Gallery Database (IGDB) (<http://www.image-archive.org/about.html>);
- Oxford Bioimage Database (<http://www.bioimage.org/>);
- BIRN (Biomedical Informatics Research Network) project – focuses on collaborative access to and analysis of images and datasets generated from neuroimaging studies. It uses the Storage Resource Broker as a distributed data management middleware layer (<http://www.nbirn.net/>);
- MEDIGRID – a French project exploring the use of the GRID technologies for tackling the processing of huge medical image databases (<http://www.creatis.insa-lyon.fr/MEDIGRID/>);
- OME Open Microscopy Environment (<http://www.openmicroscopy.org/>);
- Vannotea – A Collaborative System for Real-time annotation of Video and Images (<http://metadata.net/filmed/>).

Each of the technologies listed above have different advantages and disadvantages in this context. Some are designed for specific domains (e.g., medical images) and may not suit the multidisciplinary nature of NANO content. Others are very data-centric (e.g., Storage Resource Broker) and based purely on XML (e.g., the Metadata Catalog Service (MCAT)) and do not employ semantics to describe their data grids or the data grid services. For knowledge-driven tasks, such as intelligent automated analysis, reasoning, integration and correlation, metadata must be augmented by semantics and metadata-related tools must be “semantically-enabled”. One of the longer term aims is to investigate how the Storage Resource Broker and MCAT can be augmented through ontological (OWL) descriptions of the stored images, video and analytical data. The annotation tools will be a first step in the attachment of ontology-based descriptions of the images, videos and data.

This work will also build on existing work and collaborations already established by Dr Hunter through the Grangenet-funded FilmEd project and the MAENAD (Multimedia Access over Enterprises Networks and Domains) project that have focussed on developing image and video databases, indexing and annotation tools and multimedia ontologies for the past ten years.

D3 OUTLINE OF THE PROPOSED INITIATIVE

The plan is to break the initiative into 4 key phases over twelve months:

Phase 1: Requirements Analysis and System Design (months 1-2). This will involve:

- An analysis of requirements for both providers and consumers across the five NANO nodes;
- An analysis of existing hardware, software, storage infrastructure and legacy systems and databases in each of the nodes;
- Review of existing relevant international standards, technologies and projects;
- Development of a common approach to satisfy the wide variety of requirements, disciplines and legacy systems of NANO;
- Metadata schema design (based on the Open Microscopy Environment standard (OME) plus discipline-specific schemas and ontologies);
- Architectural system design – this will be based on existing Grid, metadata and security standards and technologies and open source software solutions e.g., Globus toolkit, SRB, Metacatalog server and the WS-Resource Framework, OWL and Shibboleth). But will involve extending these technologies where necessary to provide richer metadata and semantic descriptions for future knowledge mining;

Phase 2: Implementation (months 3-10). This will involve:

- Development of tools to enable the capture, description, storage, retrieval and analysis of scientific images and data across the nodes;
- Development of federated identity and access management tools - user login, authentication and authorization (using Shibboleth and eduPerson);
- Development of a prototype system operating between the NANO nodes at UQ and Uni. of Sydney;
- Integration of the system components – login, instrument booking system, image/data capture and storage, metadata generation, image analysis services etc.
- Construction of a testbed database of scientific images and data distributed between UQ and Uni.Sydney;
- User-friendly, intuitive graphical user interface design;
- Development of web portal with common booking system and advanced search, browse, query and presentation functionality with simple access constraints.

Phase 3: System evaluation, feedback and refinement (months 11-12). This will involve:

- Evaluation of the testbed system through user trials by NANO scientists;
- Integration and evaluation of collaborative image annotation tools (Vannotea);
- Refinement of system components based on user feedback and the results of the evaluation trials.

Phase 4 (months 12-13) – Final report and post-funding workshop.

D4 COLLABORATION

National Collaboration

Achieving the objectives of this initiative will require collaboration between a diverse range of multidisciplinary communities that include both providers and consumers of NANO facilities: manufacturers, nano-materials scientists, microscopists, micro-biologists, chemists and structural engineers in industry, research, university and government organizations. Stakeholders will include:

- University researchers, from research directors and visiting fellows to PhD and MSc students, from across Australia - from departments and research centres in metallurgy, nanotechnology, chemistry, molecular biology, bioengineering, geology, physics;

- Industry users including BHP Billiton, Alcoa, Comalco, CSIRO Mining and Exploration, Ceramic Fuel Cells Limited etc.;
- Government clients of NANO – Departments of Primary Industries, Environmental Protection departments and agencies, local and shire councils.

This initiative will also require collaboration between the materials scientists who manage the NANO nodes and the ICT researchers and software developers who will design and develop the middleware. Within this initiative, the normal cultural gap between these two groups will be reduced due to Dr Hunter's background as a metallurgist.

The outcomes of this project will encourage and facilitate collaboration between research, industry and govt users by enabling:

- the sharing and re-use of scientific research images and data amongst trusted colleagues;
- the real-time interactive analysis, discussion and sharing of images amongst distributed groups within videoconferencing environments i.e., Access Grid Nodes
- the attachment and sharing of annotations – opinions or notes attached to images, regions of images, video segments or keyframes
- the use of the archive within training and teaching within universities of both undergraduate and postgraduate students or to facilitate knowledge transfer to industry.

International Collaboration

NANO has formal relationships with several international organisations and this includes signed memorandums of understanding with the National Institute of Materials Science (NIMS) in Japan and the Nanyang Technical University in Singapore. NANO hosts at least 5 international visitors to each site per year and for the active scientists working within the nodes, international collaborative programs are an important part of their academic life. In particular NANO has close affiliations with the Argonne National Laboratory Michigan, Oak Ridge National Laboratory, Tennessee, US Airforce Office of Scientific Research, the University of Southampton, Imperial College, University of Cambridge, the University of Lille and the South African Electron Microscopy Society. Grid-enabling NANO and making its instruments, expertise and data accessible over high-speed networks, will connect the nodes both internationally as well as nationally. This will enable sharing of instruments, expertise and data with international colleagues and aid international collaboration.

In addition, Dr Hunter is collaborating with a number of UK eScience Centres (in Cambridge, Oxford, Bristol and Southampton) who are also developing large-scale image and video databases for eScience. This collaboration is funded through DEST's Innovation Access Programme (International Science and Technology) via the collaborative "Integrating Australia into Global eScience" project (CG050091).

Industry Collaboration

Apart from industry collaboration through NANO's industrial clients, this initiative will also involve collaboration with the scientific instrument industry through JEOL's involvement – JEOL is an international company with more than 50 years expertise in developing instruments used to advance scientific research and technology and the leading supplier of scientific instrumentation to NANO. Instruments developed and supported by JEOL include: scanning electron microscopes (SEMs), transmission electron microscopes (TEMs), scanning probe microscopes (SPMs), mass spectrometers, NMR spectrometers, and semiconductor tools for scientific and industrial purposes - uses range from routine analyses of organic and inorganic specimens to breakthroughs in nanotechnological development. Close collaboration with JEOL will be necessary in order to understand the intricacies of and interfaces to the image acquisition and manipulation software and hardware that accompanies each instrument. JEOL is keen to be involved in this initiative in order to maximize the interoperability and standards-compliance of their image and data capture software.

D5 INFRASTRUCTURE

The infrastructure that will be used for this initiative includes:

- The NANO network is an Australian Major National Research Facility with five nodes across the country located in the key microscopy and microanalysis centres. The total investment underpinning NANO is conservatively valued at \$70M in replacement value and spans instrumentation and expertise for microscopy and analysis using light-optics, electrons, X-rays and ion beams. The network organisation provides access to state-of-the-art tools: a nanoSIMS, a cryo-TEM, an advanced FIB and an advanced atom probe platform. Each of the individual nodes provides centralised infrastructure established within the major research Universities. Each node has extensive data storage access and runs on-line booking and usage data systems. Each node has a specialist information technologist and in each node there are different levels of telepresence capabilities for both teaching, training and research, The NANO telepresence system utilises formal linkages with GrangeNet and AARNet3 to overcome bandwidth bottlenecks associated with remote-access to the network and uses teleconferencing to communicate across the nodes. In essence the infrastructure for a more comprehensive data handling and distribution network is in place, however there are no standards across the nodes and no uniform means of storing and distributing data to the clients that currently use the system.
- GrangeNet (GRid And Next GEneration Network) is an experimental high capacity network providing advanced grid and communication services for research, development and education. The GrangeNet network comprises a 10 Gigabit backbone linking Melbourne, Canberra, and Sydney and 5 Gigabits into Brisbane. GrangeNet is used by NANO to provide the high levels of bandwidth, and remote high speed access to the instruments such as the electron microscopes, distributed across the NANO nodes.
- Grid infrastructure – through APAC partners, Qld Parallel Supercomputing Foundation (QPSF), ac3 (Australian Centre for Advanced Computing and Communications in NSW) and VPAC (Victorian Partnership for Advanced Computing), we will have access to world class Grid infrastructure that includes supercomputing and advanced storage facilities. This will enable storage across multiple distributed storage nodes and real-time processing and analysis of images and data sets through the QPSF, ac3 and VPAC high performance compute grids.
- Access Grid Nodes and videoconferencing facilities – Access Grids (AG) nodes provide the high-end audio and video technologies required for collaborative data visualization within large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials, and training. The NANO community already uses AGNs for group telemicroscopy sessions.

D6 EXPECTED OUTCOMES

The expected outcomes from this proposed initiative include:

- A secure web portal to the instruments, services, storage and expertise that comprise NANO;
- A set of common interoperable tools and services for indexing, storing, searching, retrieving and re-using nanostructural images, video and data generated by the NANO community;
- A testbed demonstrator which will provide access to a distributed digital library of multidisciplinary scientific images, video and data through a Web-based search, browse, retrieval interface;
- A model to other scientific communities in Australia and internationally, demonstrating the optimum approach to the development of distributed scientific image repositories;
- Access to a repository of image analysis tools and services and (in the longer term) scientific image capture and analysis workflows;
- The ability to quickly process and present large numbers of images using compute grid-based analytical services;

- Image and video annotation tools that promote and encourage collaborative value-add and sharing of knowledge through the attachment of peers' comments and opinions;
- Improvements in the quality of nanostructural analysis research data being generated and made available to Australian researchers – the new middleware services and richer metadata will enhance its value through greater re-usability, authenticity and reproducibility;
- A reduction in the costs associated with scientific experimentation and observational data capture due to greater sharing, accessibility and re-use of research results and analytical techniques;
- Improved eResearch infrastructure within Australia, particularly for the cost-effective management of data being generated by scientific instruments (such as the Australian Synchrotron, the ANSTO Research Reactor or laboratories such as NANO) and the mining of knowledge from this data;
- Publications in high profile international journals, conferences and workshops in the fields of eScience or eResearch;
- Increased Australian involvement in the development of international standards necessary for the global interoperability of eResearch infrastructure and an enhancement of Australia's reputation as a leader in eResearch;
- Knowledge exchange and technology transfer through collaborations and exchanges both nationally and internationally with both research and industry groups (e.g., with the UK eScience Centres) and enhanced opportunities for training of post-graduate students.

Although in the first instance the resultant middleware will be designed to satisfy the requirements of the NANO community, it will also be designed to be easily extended or refined in order to satisfy the requirements of other scientific communities with large image, video and data collections, such as particle physicists, astronomers or geophysicists.

Potential Economic, Environmental and Social Benefits

It is estimated that 30% of R&D expenditure is wasted on duplicating research that has already been carried out. Australia's ability to keep pace with richer international competitors in the knowledge economy will depend on our ability to conduct research in more efficient and collaborative ways which preclude duplication and involve high speed networked access to distributed data repositories, specialised scientific equipment, knowledge services, and computing power. By ensuring long term access, sharing and re-use of scientific images and data generated by the NANO community, this project will add value to existing R&D investments, improve the quality and extend the life of research data being generated, maximize the potential economic and social benefits derivable from the data, shorten R&D cycles, reduce duplication and improve our international competitiveness in the knowledge economy.

This project clearly addresses the National Research Priority of "Frontier Technologies for Building and Transforming Australian Industries". The primary priority goal to which the project will contribute is "Smart Information Use". In particular it will deliver improved knowledge management and mining systems for scientific communities across the *bio* and *nano* disciplines. The outcomes are also expected to make our "Frontier Technologies" including (ICT, nanotechnology and biotechnology) more productive and competitive. The sophisticated ICT infrastructure proposed will expedite the development of improved "Advanced Materials" at the nano-scale level (semiconductors, fuel cells, light alloys etc).

Initiative outcomes will be disseminated through: publications in high profile journals and conferences (e.g., IEEE Intelligent Systems, IEEE Transactions on Knowledge and Data Engineering, International Conference on Grid Computing and Applications, CCGrid); participation in international standards organizations (W3C, Global Grid Forum (GGF), Semantic Grid Working Group); public seminars, workshops and conferences both nationally and internationally. In addition, this initiative will encourage the dissemination, deployment and adoption of the project outcomes by Australian and international scientific communities through the construction of a portal to the resultant middleware for building and maintaining scientific image/data repositories; and the ongoing expansion of the testbed database into a fully-functional, useable digital library.

D7 DESCRIPTION OF PERSONNEL

Professor John Drennan, is the Director of the Centre for Microscopy and Microanalysis at The University of Queensland. This node of NANO will provide the base from which the network will be developed. Professor Drennan is also the Scientific Director of NANO and in this role provides strategic leadership in developments taking place across the network. Professor Drennan will provide the overall management of the project and will use his expertise in microscopy related areas to provide advice on the type and priority of data that will be worked on.

Dr Jane Hunter, is a Distinguished Research Fellow at the Distributed Systems Technology CRC. Dr Hunter is an internationally renowned scientist in the areas of eScience middleware, knowledge management and multimedia digital libraries. Dr Hunter has developed systems across a diverse range of topics from indigenous archives through to knowledge management systems for nano-materials optimization and advanced aerospace applications. Dr Hunter will provide the overall technical management for the ICT component of the project.

Professor Simon Ringer, is the Director of the Electron Microscopy unit at the University of Sydney and is the current Executive Director of NANO. Professor Ringer has overall responsibility for the NANO network and has a clear vision of the future requirements for NANO and the next developments. His council on trends and developments nationally and the future directions of the NANO network will provide valuable assistance in developing a robust and evolving scientific data grid.

Professor Paul Munroe is Director of the Electron Microscopy Unit of The University of New South Wales and also holds the key role in the NANO-MNRF as Technical Director. The University of New South Wales unit has developed in-house booking and logging systems that include automatic billing facilities. This has been installed in the University of Western Australia and may become the standard across the nodes. This experience at developing comprehensive networked systems that actually work and are user friendly will provide the team with valuable advice. In addition as Technical Director of NANO, Professor Munroe has a unique perspective on the latest developments in instrumentation and the requirements for data management.

Associate Professor Brendan Griffin is Director of the Centre for Microscopy and Microanalysis at The University of Western Australia. This centre has been at the forefront of developments in remote microscopy. They were the first to introduce a telepresence facility with a view to providing remote mining communities in the state with access to advanced analytical instrumentation. Brendan Griffin has an ongoing interest in developing this aspect of microscopy and his experience will provide valuable input to this project.

Professor Steven Praver is the Director of the University of Melbourne Node of NANO:MNRF, and is the chair of the Physical Sciences Panel of NANO. He also holds senior position as program manager in the Centre of Excellence for Quantum Computer Technology, and is a founding member of the Centre for Nanoscience and Nanotechnology at the University of Melbourne. He brings experience in a wide range of conventional and non-conventional analytical tools (such as nuclear microscopy) and will advise on the robustness of the developed systems to accommodate data-sets from diverse instruments.

D8 ADMINISTERING ORGANISATION CAPACITY

The University of Qld (UQ) has a strong track record in competitively-funded research, including major collaborative initiatives such as research centres and research facilities. Established management, financial and administrative systems within the University, including comprehensive, specialist services for research and research training, provide quality support to our researchers and research students.

In addition the UQ provides state-of-the art ICT infrastructure with a 155Mbps Internet link, a 1Gbps GrangeNet connection and a 50 Mbps AARNet link (soon to be upgraded to 100Mbps AARNet3 connection). The powerful microscopes located at the NANO nodes are connected via GrangeNet - enabling real-time remote microscopy across the network. NANO has been in operation since 2001 and involves in excess of 100 personnel over 5 separate sites. This organisation is administered through a management board that includes the senior executives responsible for research across the participating universities. In addition an operations group meets regularly to determine the day to day operations and set strategic agenda. This grouping includes all the directors of the facilities that make up the NANO organisation. NANO funds travel and access to the facilities and is open to researchers in Australia and overseas. This program has funded in excess of 50 researcher's to-date and is expected to expand this to 80 researchers per year for the next three years. The administrative and organisational structure of NANO has the capability of incorporating research programs and delivering on proposed outcomes.

This initiative will enhance the NANO networks ability to develop and promote nanoscience both within Australia and internationally.

Part E – CURRICULUM VITAE

PROFESSOR JOHN DRENNAN– C.V.

Name: Professor John Drennan
Current Appointment: Director, Centre for Microscopy and Microanalysis, Uni. of Queensland
Qualifications: B.Sc. (Hons) Chemistry (1974) Flinders University
Ph.D, Chemistry (1978) Flinders University

Professional Employment:

2000-present - **Director, Professor** Centre for Microscopy and Microanalysis, Uni. of Queensland
2001-present - **Scientific Director** Nanostructural Analysis Network Organisation (NANO-MNRF)
2004-present - **International Advisor International Centre for Young Scientists**, Tsukuba, Japan
International Advisor of Science KAKEN Co, Mito City, Japan
1996-2000 - **Deputy Director**, Centre for Microscopy and Microanalysis, Uni. of Queensland
1982- 1996 - **Project Leader**, CSIRO Division of Materials Science & Technology
1989 **Visiting Scientist**, IBM, T J Watson Research Centre, Yorktown Heights, NY, USA
1978-1982 **Post Doctoral Fellow**, Imperial College London

Publications in Past 5 Years:

40 Journal papers, 26 Conference presentations

10 Most Significant Publications in Past 5 Years:

1. “Microstructural Aspects of Oxygen Ion Conduction in Solids” J. Drennan and G. Auchterlonie, *Solid State Ionics* 134, 75-87 (2000)
2. “The Effect of Trace Elements on the Sintering of an Al-Zn-Mg-Cu Alloy” G B Schaffer, Sh Huo, J Drennan, and G J Auchterlonie, *Acta Materialia*, 49, 2000, 2671-2678
3. “HRTEM Study of the Orthorhombic Zirconia in MgO-PSZ” Z Liu, Y Bando, and J Drennan, *Journal of Applied Crystallography*, 36, 1026-1029 (2003)
4. “Precursor Scavenging of Resistive Grain-Boundary Phase in 8mol% Ytterbia-Stabilised Zirconia” J H Lee, T Mori, J G Li, T Ikegami, J Drennan, D Y Kim, *Journal of Electrochemical Society*, 149, 35-40, 2002
5. “Scavenging of Silicious Grain Boundary Phase of 8mol% Ytterbia-Stabilised Zirconia without Additive” J H Lee, T Mori, J G Li, T Ikegami, J Drennan, and D Y Kim, *Journal of American Ceramic Society*, 84, 2734-2736, 2001
6. “Influence of synthesis parameters on the formation of mesoporous SAPOs” X.S Zhao, G Q Lu, A K Whittaker, J Drennan and H Xu, *Microporous and Mesoporous Materials* 55 (2002) 51-62
7. “Electrolytic properties and nano-structural features in La₂O₃-CeO₂ system” T Mori, J Drennan, Y Wang, J-H Lee, Ji-G Li, and T Ikegami, *J. Electrochem. Soc.*, 150 (6) A665-A673, (2003)
8. “The Effect of Iron on Liquid Film migration and Sintering of an Al-Cu-Mg Alloy” W A G McPhee, G B Schaffer and J Drennan, *Acta Materialia* 51/13 (2003) 3701-3712
9. “Realizing the Hydrogen Economy through Semantic Web Technologies” J Hunter, J Drennan, and S Little, *IEEE, Intelligent Systems*, 19, 1, (2004)
10. “Formation of spinel from olivine” Z Liu, P M Kelly, J Drennan, P Mora, and H Kanda, *Applied Physics Letters* 84, 11, 1856-1858 (2004)

Funding (last five years):

Peer-Reviewed Research Grants Awarded: ~ \$2.05 million , 2 ARC-LIEF grants, 3 ARC /Discovery Grants, 2 ARC Linkage Industry Grants,
AusIndustry Major National Research Facilities Program, Nanostructural Analysis Network Organisation, (S.P. Ringer, J. Drennan, B. Griffin, P.R. Munroe and S. Prawer); 2002-2007, \$11.5M Plus \$7,530,000 in supporting funds

Postgraduate Students (last 5 years) 4 graduated

DR JANE HUNTER– C.V.

Name: Dr Jane Hunter
Current Appointment: Distinguished Research Fellow, CRC for Enterprise Distributed Systems Technology, University of Queensland
Qualifications: B.Sc (Materials) 1978, University of Queensland
 B.Eng (Honours) (Metallurgical) 1981 University of Queensland
 PostGrad. Dip. Comp. Sci. 1987, University of Queensland
 PhD (Computer Science) 1994, University of Cambridge

Appointments and Employment History:

2000 – now Project Leader, CRC for Enterprise Distributed Systems Technology, UQ
 2005 – now Co-chair Asia-Pacific Advanced Networks eScience Working Group
 2004 – now Editorial board of IEEE Multimedia and Elsevier Journal of Web Semantics
 2002 – now Liaison between MPEG (Moving Pictures Experts Group) and W3C (World Wide Web Consortium)
 1995-1999 Senior Research Scientist, Distributed Systems Technology CRC, UQ
 1991-1993 Consultant, Cambridge Animation Systems
 1990 Lecturer, University of Queensland Computer Science Department

10 Most Significant Publications in Past 5 Years (plus 3 book chapters, 10 peer-reviewed journal papers, 21 peer-reviewed conference papers)

1. J.Hunter, S.Choudhury, "Semi-Automated Preservation and Archival of Scientific Data using Semantic Grid Services", accepted Semantic Infrastructure for Grid Computing Applications Workshop, CCGRID 2005, Cardiff, May 2005
2. S.Little, J.Hunter, "Rules-By-Example - A Novel Approach to Semantic Indexing and Querying of Images", International Semantic Web Conference ISWC 2004, Hiroshima, Nov 2004.
3. J. Hunter, K. Falkovych, S. Little, "Next Generation Search Interfaces - Interactive Data Exploration and Hypothesis Formulation", European Conference on Digital Libraries ECDL 2004, Sept, 2004
4. J.Hunter, R.Schroeter, B.Koopman, M.Henderson, "Using the Grid to Build Bridges between Museums and Indigenous Communities", 11th GGF Semantic Grid Applications Workshop, Honolulu, June, 2004.
5. J.Hunter, J.Drennan, S.Little, "Realizing the Hydrogen Economy through Semantic Web Technologies", IEEE Intelligent Systems - Special Issue on eScience, Jan-Feb 2004;
6. R.Schroeter, J.Hunter, D.Kosovic, "Vannotea – A Collaborative Video Indexing, Annotation and Discussion System for Broadband Networks", Knowledge Markup and Semantic Annotation Workshop, K-CAP 2003, Sanibel, Florida Oct 2003.
7. M.Doerr, J.Hunter, C.Lagoze, "Towards a Core Ontology for Information Integration", Journal of Digital Information, Volume 4 Issue 1, Article No. 169, April 2003.
8. J. Hunter, "Enhancing the Semantic Interoperability of Multimedia through a Core Ontology", IEEE Transactions on Circuits and Systems for Video Technology, Special Issue on Conceptual and Dynamical Aspects of Multimedia Content Description, Feb 2003
9. J. Hunter, "Adding Multimedia to the Semantic Web - Building an MPEG-7 Ontology", International Semantic Web Working Symposium (SWWS), Stanford, Aug, 2001.
10. J. Hunter, C. Lagoze, "Combining RDF and XML Schemas to Enhance Interoperability Between Metadata Application Profiles", Tenth International World Wide Web Conference WWW10, Hong Kong, May 2001.

Funding (last five years):

| Funding Body | Purpose | Period | Amount |
|--|---|-----------|-------------|
| AusIndustry Innovation Access Programme | "Integrating Australia into Global eScience" CG050091 | 2004-2006 | \$320,000 |
| GrangeNet – DoCITA's Advanced Networks Programme | "Virgil – Virtual Meeting Archival" | 2005-2006 | \$150,000 |
| | FilmEd/Vannotea – "Collaborative Indexing, Annotation Tools for Access Grid Nodes" | 2002-2004 | \$450,000 |
| Qld-Smithsonian Fellowship | Collaboration with the Smithsonian | 2001 | \$30,000 |
| DISR Technology Diffusion Program | Travel funds for Harmony International Digital Library project | 1999-2001 | \$20,000 |
| DLI2 NSF International Digital Library Program | Harmony International Digital Library Project – Cornell Uni., DSTC and Uni of Bristol | 1999-2002 | \$US240,000 |

PROFESSOR SIMON P RINGER – C.V.

- Name:** Professor Simon Ringer
- Current Appointment:** Professor (Personal Chair in Microscopy & Materials Science) and Director, Electron Microscope Unit (EMU), University of Sydney; Executive Director and CEO of the NANO Major National Research Facility
- Qualifications:** B.App.Sc. 1985 Uni of South Australia;
Ph.D. 1991 UNSW; Fellow, Inst. Engineers Australia, 2001.

Relevant Employment History:

- 2005-current Board Director & Co-founder: NANOAnalysts Pty Ltd.
- 2002-current Executive Director & CEO of NANO-MNRF
- 2001-2004 Associate Professor and Director, Electron Microscope Unit, University of Sydney
- 1998-2001 Senior Lecturer (DME, Monash)
- 1996-1998 Lecturer (DME, Monash)
- 1994-1996 JSPS Postdoctoral Fellow (IMR Tohoku University, Japan)

Key Relevant Research Publications (2000-present)

(39 refereed journal papers and 18 refereed conference papers over this period)

1. Germanium-Rich Starburst Cores in Silica-Based Optical Fibres Fabricated by Modified Chemical Vapour Deposition. McNamara, P.; Lyytikäinen, K.J.; Ryan, T.; Kaplin, I.J.; Ringer, S.P. *Optics Communications*, **2004**, 230, 45-53.
2. Growth of Boehmite Nanofibers by Assembling Nanoparticles with Surfactant Micelles. Zhu, H. Y.; Gao, X. P.; Song, D. Y.; Bai, Y. Q.; Ringer, S. P.; Gao, Z.; Xi, Y. X.; Martens, W.; Riches, J. D.; Frost, R. L. *Journal of Physical Chemistry*, **2004**, 108B, 4245-4247.
3. Precipitation Processes in an Al-2.5Cu-1.5Mg (wt. %) Alloy Microalloyed with Ag and Si. K. Raviprasad, K.; Hutchinson, C.R.; Sakurai, T.; Ringer, S.P. *Acta Materialia*, **2003**, 51, 5037-5050.
4. Case Studies in Nanostructural Analysis for Understanding Nanomaterials. Ratinac, K.R.; Zhu, H. Y.; Stadtmueller, L. M.; Ringer, S.P. *Materials Forum*, **2002**, 26, pp. 44-76, invited review.
5. Soft Magnetic Properties of Ge-doped Nanocrystalline Fe-Zr-B Alloys. Suzuki, K.; Cadogan, J. M.; Aoki, K.; Ringer, S.P. *Journal of Magnetism and Magnetic Materials*, **2002**, 254-255, pp. 441-443.
6. Determination of Al Compositional Profiles Across AlAs/GaAs Heterostructural Interface At Sub-Nanometer Spatial Resolution by Thickness Fringe Imaging. Cai, D.; Zou, J.; Chen, G.; Lu, W.; Chen, X.; Ringer, S.P. *Scripta Materialia*, **2002**, 47, 279-283.
7. Effect of Specimen Size and Temper Embrittlement on Charpy Impact Testing of a Cr-Mo-V Rotor Steel. Shekhter, A.; Pereloma, E.V.; Ringer, S.P. *Mater. Sci. Technol.*, **2001**, 17, 141-147.
8. Precipitation Processes in Al-Cu-Mg Alloys Microalloyed with Si. Hutchinson, C.R.; Ringer, S.P. *Metall. and Mater. Trans.*, **2000**, 31A, 2721-2731.
9. Microstructural Evolution and Age Hardening in Aluminium Alloys: Atom Probe Field Ion Microscopy and Transmission Electron Microscopy Studies. Ringer, S.P.; Hono, K. *Materials Characterisation*, **2000**, 44, 101-131, invited review.
10. The Chemistry of Precipitates in Aged Al-2.1Zn-1.7Mg at.% Alloy. Maloney, S.K.; Hono, K.; Polmear, I.J.; Ringer, S.P. *Scripta Materialia*, **1999**, 41, 1031-1038.

Competitive Grant Funding (2000-present)

- Peer-Reviewed Research Grants Awarded: ~ \$3.6M, 2 ARC LIEF/RIEF grants, 4 ARC Discovery Project Grants (or Large Grants), 2 ARC Linkage Projects Grants.
- AusIndustry Major National Research Facilities Program, Nanostructural Analysis Network Organisation, (S.P. Ringer, J. Drennan, B. Griffin, P.R. Munroe and S. Praver), 2002-2007: \$11.5M plus \$7,530,000 in supporting funds.
- Grant funding from other sources: ~ \$0.83 M

Graduated Students: 3 PhD and 2 MSc

PROFESSOR PAUL MUNROE – C.V.

Name: Professor Paul Munroe
Current Appointment: Director, Electron Microscope Unit, University of New South Wales
Qualifications: B.Sc. (Hons) Metallurgy & Materials (1984). University of Birmingham
Ph.D, Metallurgy & Materials (1987). University of Birmingham
Grad. Dip., H. Ed. (1998). University of New South Wales

Professional Employment:

Oct 1987 - Aug 1990, Research Assistant Professor, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire, USA.

Sept 1990 - June 1994, Director of the Physical Sciences Electron Microscope Unit, UNSW

Jun 1994 - Apr 1995, Senior Lecturer, Department of Materials Engineering, Monash University.

May 1995 – December 1998, Deputy Director, Joint Electron Microscope Unit, UNSW

Jan 1999 – Dec 2002, Director, Joint Electron Microscope Unit, UNSW (Also Associate Professor - School of Materials Science and Engineering).

Jan 2003 – Present, Director, Joint Electron Microscope Unit, UNSW (Also Professor - School of Materials Science and Engineering).

Publications in Past 5 Years:

65 Journal papers, 29 Refereed conference papers.

10 Most Significant Publications in Past 5 Years:

1. "The Development of Fe-Zn Intermetallic Compounds in Solid Fe/Zn And Fe/Zn-Al Diffusion Couples During Short-Term Annealing at 400C", Syahbuddin, P.R. Munroe and B. Gleeson, *Mater. Sci. and Eng.*, A264, 201-209 (1999).
2. "Transmission Electron Microscope Specimen Preparation of Metal Matrix Composites Using the Focused Ion Beam Miller", J. M. Cairney, R. D. Smith and P. R. Munroe, *Microscopy and Microanalysis*, 5, 452-462 (2000).
3. "Microstructural Analysis of FeAl-Quasicrystal Composites Prepared Using a Focused Ion Beam Miller", J.M. Cairney, P.R. Munroe and D.J. Sordelet *J. Microscopy*, 201, 201-211, (2001).
4. "Fracture Toughness, Fracture Morphology, and Crack Tip Plastic Zone of a Zr-Base Bulk Amorphous Alloy, J.H. Schneibel, J.A. Horton, and P.R. Munroe, *Metall. Mater. Trans.*, **32A**, 2819-2826 (2001).
5. "Microstructure, Mechanical Properties and Wear of Ni-Al-Fe Alloys", P.R. Munroe, M. George, I. Baker and F.E. Kennedy, *Mater. Sci. and Eng.*, **A325**, 1-8 (2002).
6. "Metal Dusting of Fe-Cr and Fe-Ni-Cr Alloys under Cyclic Conditions", C.H. Toh, D.J. Young and P.R. Munroe, *Oxidation of Metals*, **58**, 1-21 (2002).
7. "The Paramagnetic to Ferromagnetic Transition in B2-structured FeAl Single Crystals: Experiments and Calculations", D. Wu, P.R. Munroe and I. Baker, *Phil. Mag.*, **83**, 295-313, (2003).
8. "Enhanced Recovery in an Aluminium Alloy Containing Alumina Particles", M. Ferry and P. R. Munroe, *Mater. Sci. and Eng. A*, **358**, 142-151, (2003).
9. "Scratch Damage in Ceramics: Role of Microstructure", Z-H Xie, M. Hoffman, R. Moon, P.R. Munroe and Y-B Cheng, *J. American Ceramic Soc.*, **86**, 141-148, (2003).
10. "On the path dependence of the thermal vacancy concentration in stoichiometric FeAl", J. H. Schneibel and P.R. Munroe, *Intermetallics*, **12**, 111-115, (2004).

Funding (last five years):

Peer-Reviewed Research Grants Awarded: ~\$1,500,000 (including 3 ARC-LIEF grants, 3 ARC Large/Discovery Grants, 2 ARC Linkage Industry Grant, 2 ARC Linkage International Award)

AusIndustry Major National Research Facilities Program, Nanostructural Analysis Network Organisation, (S.P. Ringer, J. Drennan, B. Griffin, P.R. Munroe and S. Prawer); 2002-2007, \$11.5M Plus \$7,530,000 in supporting funds

Graduated Students: 16 PhD

ASSOCIATE PROFESSOR BRENDAN JOHN GRIFFIN – C.V.

Name: Associate Professor Brendan Griffin
Current Appointment: Director, Centre for Microscopy & Microanalysis.
University of Western Australia
Qualifications: B.Sc. (Hons) Chemistry (1974) University of Tasmania
Ph.D, Chemistry (1983) University of Tasmania

Professional Employment

2002- **Director**, Centre for Microscopy & Microanalysis, The University of Western Australia
2002- **Director**, Western Australian Centre for Microscopy (WACM)
2001- **Associate Director**, Nanostructural Analysis Network Organisation (NANO-MNRF)
2001-02 **Deputy Director**, Centre for Microscopy & Microanalysis, University of WA
1992-99 **Senior lecturer**, Centre for Microscopy & Microanalysis, University of WA
1995 **Visiting Research Fellow**, Imperial College London
1987-92 **Lecturer**, Centre for Microscopy & Microanalysis, University of Western Australia
1982-87 **Electron Microprobe Analyst**, Electron Optical Centre, The University of Adelaide
1980-82 **Postdoctoral Fellow**, Max Planck Institute for Chemistry, Mainz, West Germany

Publications in Past 5 Years:

19 Refereed journal articles, 1 book chapter, 59 refereed conference publications

10 Most Significant Publications in Past 5 Years:

1. Griffin, B.J. (2000): "Charge contrast imaging of material growth and defects in Environmental Scanning Electron Microscopy – linking electron emission and cathodoluminescence." *Scanning*, **22**, pp. 234-242.
2. Watt, G.W., Griffin, B.J., and Kinny, P.K. (2000): " Charge contrast imaging of geological materials in the environmental scanning electron microscope." *Amer. Mineralogist*, **85**, 1784-95.
3. Galvin, S.P., Griffin, B.J. and Browne, J. (2001): "Imaging of surface strain and polishing artefacts in fused silica by environmental scanning electron microscopy." *J. Materials Science*, **36(23)**, 5683-96.
4. Baroni, T.C, Griffin, B.J., Cornell, J.B., Roach, G.I.D. and Lincoln, F.J. (2002): " Three-Dimensional Reconstruction of Microstructures in Gibbsite Using Charge Contrast Images" *Scanning*, **24**, 18-24.
5. De Corte K., Trautman R., Griffin B. and De Paepe P., 2002. Internal morphology of microdiamonds from UHPM rocks of the Kokchetav Massif, Kazakhstan. In: Parkinson C.D., Katayama I., Liou J.G. and Maruyama S. (eds.) *The Diamond-Bearing Kokchetav Massif, Kazakhstan*. Universal Academy Press, Tokyo, Japan. 103-135.
6. Bulanova, G.P., Pearson, D.G. Hauri, E.H. and Griffin, B.J. (2002): "Carbon and Nitrogen isotope systematics within a sector-growth diamond from the Mir kimberlite, Yakutia." *Chemical Geology*, **188**, 105-123.
7. McMenamin, P.G., Djano, J., Wealthall, R. and Griffin, B.J. (2002): "Characterization of the Macrophages associated with the Tunica Vasculosa Lentis of the Rat Eye." *Investigative Ophthalmology and Visual Science*, **43(7)**, 2076-82.
8. **[Invited]** Griffin, B.J. (2003): "Towards optimal imaging and microanalysis in variable pressure and low voltage SEM." *Microsc Microanal*, **9(S2:Proceedings)**, 974-5.
9. Griffin, B.J., and Suvorova, A.A. (2003): "Charge-Related Problems Associated with X-ray Microanalysis in the Variable Pressure Scanning Electron Microscope at Low Pressures." *Microsc Microanal*, **9**, 155-65.
10. **[Invited]** Griffin, B.J. , Stern, R., Bulanova, G. and Trautman, R.L. (2004): "Nitrogen and Hydrogen in Natural Diamond, and other Stuff - Challenges of Correlative Microanalysis using Ions, Electrons and X-rays." *Microsc Microanal*, **10 (S2:Proceedings)**, 96-7.

Funding (last 5 years)

In total, I have been involved in successful grant applications as a Chief Investigator totalling \$13,614,000 in the 2002-5 period.

Peer-Reviewed Research Grants Awarded: 4 ARC-LIEF grant, 2 ARC /Discovery Grants, 1 WA Centre of Excellence grant, 1 UWA Research grant

AusIndustry Major National Research Facilities Program, Nanostructural Analysis Network Organisation, (S.P. Ringer, J. Drennan, B. Griffin, P.R. Munroe and S. Praver); 2002-2007, \$11.5M

Graduated Students: 4 PhD and 2 MSc

PROFESSOR STEVEN PRAWER – C.V.

Qualifications: BSc (Hons), Monash University, 1980;
PhD, Monash University, 1985; DSc. University of Melbourne, 1998

Current Appointment: Associate Director and Chair, Physical Sciences Panel, Nanostructural Analysis Network Organisation (NANO MNRF) and Professor, School of Physics, University of Melbourne (2002-present)

Relevant Employment History

2002-current Professor of Physics, University of Melbourne
2002-current Associate Director, Nanostructural Analysis Network Organization
2000-2002 Director, Melbourne Node of the CoE Quantum Computer Technology
1996-2001: Associate Professor and Reader, School of Physics, University of Melbourne
1992-1995: Senior Lecturer, School of Physics, The University of Melbourne.
1991 Tenured Lecturer, School of Physics, The University of Melbourne.
1988-1990: Senior Lecturer, Department of Applied. Physics, RMIT
1987-1988: Lecturer, Department of Applied Physics, Royal Melbourne Institute of Technology.

Publications (ten most relevant, 2000-2004) (Last 5 years: 5 Patents; 53 Refereed Journal Papers; 17 refereed conference papers, 4 book chapters)

1. “Raman Investigation of the Nature of Damage Caused by Deep Ion Implantation in Diamond” Orwa, J., Jamieson, D.N, Nugent, K.W., and **Prawer, S.**, Phys. Rev B. **62**, 5461-5472, (2000)
2. “Field Emission from Boron Doped polycrystalline diamond film at the nanometre level within grains”, Andrienko, I., Cimmino, A., Hoxley, D., **Prawer, S.**, Kalish, R., Appl. Phys. Lett., **77**, 1221 (2000).
3. “The Raman spectrum of Nanocrystalline Diamond” **Prawer, S.**, Nugent, K.W., Jamieson, D.N., Orwa, J.O., Bursill, L.A., and Peng, J.L., , Chemical Physics Letters, **332**, 93-97, (2000)
4. “The size dependence of structural stability in Nanocrystalline Diamond” **Prawer, S.**, Peng, J.L, Jamieson, D.N, McCallum, J., and Bursill, L.A., , Phys. Rev. B. **62**(24):R16360-R16363, (2000)
5. “Temperature Dependence of the First Order Raman Phonon of Diamond” Liu, M., Bursill, L.A., **Prawer, S.**, and Besserman, R., Phys. Rev. B. **61**, 3391-3395, (2000).
6. “Diamond nanocrystals formed by direct implantation of fused silica with carbon”, Orwa, J.O., **Prawer, S.**, Jamieson, D.N., et al. J. Appl. Phys. **90**, 3007-3018, (2001)
7. “Temperature Dependent emptying of grain boundary charge traps in CVD diamond,” Hearne, S.M., Jamieson, D.N., **Prawer, S.**, Trajkov, E., and Butler, J.E., Appl. Phys. Lett, **84**, 4493-4495(2004).
8. “Identification of the point defects in Diamond as measured by Raman Spectroscopy: Comparison Between Experiment and Computation”, **Prawer, S.**, Rosenblum, I., Orwa, J.O., and Adler, J., Chemical Physics Letters, **390**, 458-461, (2004).
9. “Raman Spectroscopy of Diamond and Doped Diamond” **Prawer, S.**, and Nemanich, R. , Philosophical Transactions and the Royal Society of London Series A- Mathematical, Physical and Engineering Sciences, **362**, 2537-2565, (2004)
10. “Electron trapping and detrapping in ion-beam-damaged diamond surfaces”, A. Hoffman, I. Andrienko, D.N. Jamieson and **S. Prawer**, Applied Physics Letters, **86**, pp.44103-1-3. (2005).

Research Funding (last five years):

| | |
|---|----------|
| ARC (SPIRT) 2001-2, Development of microsensors | \$42K |
| ARC 2000-2, Special Research Center for Quantum Computer Technology: | \$935K |
| ARC RIEF 2001, New Ways of Seeing | \$800K |
| ARC (Large) 2001, Carbon Nanostructures: Synthesis and Characterization | \$90K |
| Texas Engineering Experimental Station 2001-2, Fabricating Novel Diamond....., | \$152K |
| MNRF 2002 total funding, Nanostructural Analysis Network Organization | \$11.5M. |
| ARC LIEF 2002, Novel Optical Microprobes: Fluorescence excitation, lifetime and ... | \$326K |
| ARC 2003-7 total funding, Center of Excellence for Quantum Computer Technology: | \$14M |
| ARC Discovery, Diamond Quantum Dots Fabricated by Ion Implantation | \$340K |

Graduated Students: 10 PhD and 4 MSc students

PART F—INDUSTRY PARTNER ORGANISATION DETAILS

Part F must be completed for each Industry Partner

Note: Industry partners are not mandatory however collaboration with Australian industries or international groups of researchers, in multi-disciplinary projects in better utilising the existing ICT infrastructure is encouraged.

F1 INDUSTRY PARTNER ORGANISATION CONTACT DETAILS

Organisation contact

| | | | | | |
|-----------------------|--------------------------|--------------------|--------------|--------------|----|
| Family name | Lozbin | | | Title | Mr |
| First name | Vitaly | Second name | | | |
| Position title | Customer Support Manager | | | | |
| Phone | 02 9905 8255 | Fax | 02 9905 8286 | | |
| Email | vlozbin@jeol.com.au | | | | |

Organisation postal address

| | | | | | | | |
|------------------------------|------------------------------|--------------|-----|-----------------|------|----------------|-----------|
| Organisation | JEOL (Australasia) Pty Ltd | | | | | | |
| Postal address line 1 | Unit 9, 750-752 Pittwater Rd | | | | | | |
| Postal address line 2 | | | | | | | |
| Locality | Brookvale | State | NSW | Postcode | 2100 | Country | Australia |

Other organisation details

| | | | |
|---|---------------------------------|---------------|-----|
| Australian Business Number (ABN) | 69000519620 | ANZSIC | 283 |
| Web page address (URL) | http://www.jeol.com.au/ | | |
| Organisation Type | Private Company - International | | |

F2 INDUSTRY PARTNER CONTRIBUTION

| | |
|--------------------------------|----------------|
| Amount Committed (2005) | |
| 0 | Cash |
| 20000 | In-Kind |
| 20000 | Total |

F3 INDUSTRY PARTNER CERTIFICATION

I certify that the above contribution will be made available to the initiative

(For Government Agencies) No part of our cash contribution is drawn from funds previously appropriated from government sources for the purposes of research, evaluation and/or consultancy activity and

I have read and understood the requirements in the Funding Agreement about industry partner Agreements including the requirement to enter into arrangements for intellectual property.

Signature of CEO (or delegated officer)

Name (please print)

Date

F4 INDUSTRY PARTNER LETTER OF SUPPORT

Attach the letter of support from the industry partner to this application.