

NATIONAL RESEARCH FOUNDATION

PRESS RELEASE

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NRF ANNOUNCES SECOND GROUP OF RESEARCH PROGRAMMES TO RECEIVE FUNDING UNDER THE COMPETITIVE RESEARCH PROGRAMME FUNDING SCHEME AND A NEW SCENARIO-BASED GRANT CALL

- *NRF selected four research programmes to receive funding under the Competitive Research Programme Funding Scheme's second grant call*
- *New scenario-based grant call to be launched on the subject of ageing*

1. The National Research Foundation, on the recommendation of the International Evaluation Panel (IEP) for its Competitive Research Programme (CRP) Funding Scheme, announced today the second group of research proposals to be awarded grants under the General grant call of the Scheme. (See Annex 4 for the list of IEP members.)

2. The CRP Funding Scheme offers substantial funding support of up to S\$10 million per proposal, over three to five years. The aim of the CRP Funding Scheme is to identify future strategic research areas for Singapore by funding research ideas at a programme level that enables the support of interdisciplinary research. (See Annex 1 for a description of the CRP Funding Scheme.)

3. The second CRP grant call, launched on 13 November 2007, received a total of 50 preliminary proposals submitted by Singapore-based researchers from local universities, public research entities as well as private companies. The proposals span the full spectrum of science and technology areas. Twelve preliminary white papers were selected to be developed into full proposals. These full proposals were internationally peer-reviewed. The IEP met to review the full proposals and recommended four for funding. Two of the four selected programmes were resubmissions from the 1st CRP call.

4. The four research programmes awarded funding by NRF are:

- Biodegradable Cardiovascular Implants
- Biologically-Inspired Design, Nano-Fabrication and Nano-Lubrication of MEMS, NEMS and Micro-Mechanical Devices
- Theory and Practice of Coding and Cryptography

- Towards Manufacturability of Carbon Nanotube-Based Printed Electronics

(See Annex 3 for more details)

5. The IEP also discussed and confirmed the launch of the Scenario-based CRP grant calls as an alternative approach to soliciting research proposals. Under this Scenario-based approach, the NRF will articulate a scenario that may be a potential major challenge and opportunity for Singapore in the future and invite the research community to propose research programmes that will address fundamental scientific and technological problems presented by the given scenario.

6. The aim of the Scenario-based CRP is to encourage R&D in these areas that would pave the way for creating new industries. It will complement the existing General CRP grant calls by providing a tighter linkage between funded CRP programmes and potential solutions or opportunities for Singapore. The inaugural Scenario-based grant call will be on the subject of ageing. (See Annex 2 for more details.)

7. Dr Rita Colwell, Chair of the IEP and a member of NRF's Scientific Advisory Board, said: "Once again, we are encouraged and enthusiastic about the programmes selected for funding. We are optimistic that the research will produce outcomes which push the frontiers of science and technology, and generate economic and societal benefits for Singapore. The Scenario-based CRP grant call is an interesting approach to pursue and the subject of 'ageing' is clearly of great relevance to the world. I look forward to interesting proposals coming out of this call."

8. Prof Mary Chan, whose programme was selected to receive funding, said: "I am very glad that our proposal is finally selected and we are highly appreciative of the support and encouragement from the school and NTU. I have been really pleased to be back in Singapore, which has been highly supportive of investigator-driven R&D and that my research could benefit from this new thrust towards research excellence of international standards."

9. CRP grant calls are launched on a twice-yearly basis. The inaugural Scenario-based grant call opened on 13 June 2008.

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ANNEX 1

The Competitive Research Programme Funding Scheme

The Competitive Research Programme (CRP) Funding Scheme complements the existing Strategic Research Programmes that have been identified as top-down, by funding a broad base of research ideas, through a competitive bottom-up approach. This will help to identify new potential strategic research areas in which Singapore can invest to develop core capabilities for new industries of the future.

The CRP Funding Scheme will support R&D programmes, each comprising multiple related projects under a unifying theme. Each award is for a maximum of S\$10 million per programme, over three to five years. There are expected to be two rounds of grant calls each year.

While the CRP Funding Scheme is open to all areas of science and technology, preference will be given to areas that fall outside of the focus of existing NRF Strategic Research Programmes, such as the Biomedical Sciences Translational and Clinical Research (BMS TCR), Environmental and Water Technologies (EWT), and Interactive and Digital Media (IDM).

Open to both public and private sector participants, the CRP Funding Scheme aims to encourage collaboration and partnerships between academia and industry. By funding at the programme level, a more coordinated and integrated support of high-impact inter-disciplinary research is possible as a larger budget can be allocated to fund a number of related projects to address a given problem.

The CRP Funding Scheme involves two types of calls: General and Scenario-based calls.

Overview of General and Scenario-based CRP

General CRP

The General CRP allows the Principal Investigators (PIs) to surface any new area of research with potential economic and societal benefits for Singapore through a bottom-up approach. Calls for the General CRP will be held annually. Each proposal should be submitted by a Lead PI, who is expected to be actively involved in the overall management of the programme and who will be accountable for the research and its deliverables.

CRP proposals should demonstrate the following:

- i. High quality cutting-edge science;
- ii. High likelihood of building up research infrastructure and capabilities in Singapore;
- iii. Competent team consisting of individuals with credible track records;
- iv. Excellent execution of individual projects which form a coherent programme; and
- v. High potential to generate economic and societal benefits to Singapore by creating new industries or advancing existing industries.

Scenario-based CRP

The Scenario-based approach to identifying research programmes will complement the General CRP scheme. The Scenario-based CRP aims to support R&D programmes that are truly use-inspired and able to produce technical breakthroughs to big challenges and opportunities for Singapore.

In each Scenario-based call, NRF will articulate a future scenario that offers a major challenge or opportunity for Singapore. The research community will be invited to submit proposals for research programmes that will address key scientific and technological challenges presented by the given scenario.

In addition to the basic criteria for General CRP proposals, Scenario-based CRP proposals will also be evaluated on the following:

- i. Extent to which the proposed R&D programme address the challenges or opportunities posed by the given scenario;
- ii. Relevance and importance of the proposed R&D programme in terms of the economic, technological, social and environmental impact on Singapore; and
- iii. Quality of the proposed R&D programme, compared to similar international efforts elsewhere.

Eligibility

Principal Investigators from all Singapore-based institutions of higher learning (IHLs), public sector agencies and research institutions, not-for-profit hospitals and research laboratories as well as companies and company-affiliated research laboratories, are eligible to apply. Support for private sector organisations which are based in Singapore would be provided on a co-funding basis.

Only research conducted in Singapore may be funded under the CRP.

R&D proposals already funded by other Singapore agencies would not be considered under the CRP.

Evaluation of Proposals

Both the General CRP and Scenario-based CRP involve a two-stage proposal submission process. Proposals submitted will be evaluated and shortlisted by a Local Evaluation Panel in the first stage. Shortlisted submissions will be asked to be developed into full proposals and sent for international peer review. The final evaluation and selection of projects to be awarded will be made by NRF on the recommendation of the CRP International Evaluation Panel (IEP).

Applications

Calls for both the General CRP and the Scenario-based CRP are publicised on NRF's Research, Innovation and Technology Administration (RITA) system. Interested applicants may find out more about the specific CRP calls that are open and submit their applications through the system.

For more information, please visit <https://rita.nrf.gov.sg>.

ANNEX 2

Singapore in 2020

Fast-forward to 2020...

With over 25% of its population above the age of 65 years old, Singapore, like many other developed countries around the world, has a distended grey population. The average lifespan has extended to 97 years old for women and 92 years old for men. Retirement age has correspondingly shifted upward to 75 years old. With this changing demographic brought about by advances in healthcare and falling birth rates, Singapore needs to address these challenges immediately through new technologies, relevant policies and programmes. To maintain a high quality of life, there would be increasing demand for assistive technology to help the aged stay in the workforce longer and lead independent lives; a healthcare system that relies on advanced home diagnostics and the need to cater to the special dietary preferences of the elderly; a requirement to put in place advanced geriatric health management systems in public hospitals, etc.

These challenges are likely to place additional pressures on the healthcare and social systems that may not be equipped to cope with this change. On the other hand, this new evolving demographic, could present a potentially large and affluent elderly consumer market with a technologically stimulating set of demands and needs. The opportunities that accompany this rise in aging populations are tremendous as we seek to address their special array of needs.

Below are some examples of technologies for an ageing society:

- *Robotics technology, systems which consist of sensors, actuators and mechanisms, and, computers and their software, and incorporating information technology mature enough to be applied to several systems in our daily life. Some expectations: robots capable of lifting/carrying the elderly down staircases and corridors; robots that fold laundry and perform heavy-duty cleaning; and autonomous personal transportation robots capable of moving safely through busy intersections.*
- *Transforming the healthcare system. Developing technologies to keep people well and moving the health care from the hospital to the home. New computer-based technologies and innovations in sensors, software and wireless technologies that can allow such vital information as heart rate, respiratory rate, blood pressure and sleep patterns to be tracked remotely. Broadband Internet connectivity that allows the data to be shared real-time between seniors and healthcare professionals,*

as well as amongst family members and friends who deliver the majority of care to seniors.

- *Bio-medical technologies that compensate for the impairments brought about through the ageing process, e.g. Prosthetic vision for persons whose ocular nerve has degenerated from ageing.*
- *Basic molecular mechanisms believed to underlie age-related dysfunction, with a focus on molecular studies, performed primarily in cell culture and model organisms. Genetic manipulations that affect the length and/or quality of life, as well as molecular and cellular mechanisms including mitochondrial dysfunction, cell senescence, changes in gene expression/signal transduction, DNA damage and repair, stress responses and protein homeostasis. Therapeutic application of stem cells in the emerging field of regenerative medicine with respect to degenerative diseases and functional declines that accompany ageing. The role of stem cells in preventing adverse age-related changes due to loss of specific cell types. Stem cells for the treatment of neurological disorders. Age-related cognitive decline.*
- *Design for an aging population. Crucial human factor design for enhancing productivity and operability of an aging workforce. Energy balance indicators, such as “smart” clothing, household or office furnishings, that incorporate sensors, bar codes or other identifying technologies to calculate energy expenditure. Mathematical models for predicting interrelationships between energy balance and weight control in the aged.*
- *Studies translating what has been learned about aging processes from the basic behavioral and social sciences to practical outcomes, including new technologies for the benefit of the aged or stimulate new “use-inspired” basic research in the behavioral and social sciences.*
- *Integrating Biology and Genetics with Behavioral and Social Sciences, Including Implications for Data Collection and Models of Analysis. E.g. Biomarkers can contribute to understanding how psychological, social and behavioral factors interact with biology to influence health outcomes at older ages.*
- *Bioengineering tools that integrate self-reported information with biologic and/or sensor measures of physical activity, diet/nutrition, and energy balance/obesity. (This would include tools that measure this integrated information in real-time.)*
- *Neuroeconomics applies psychological, economic, and neuroscience approaches to the study of motivated choice, economic decision making, and valuation or utility as typically understood in economic terms. E.g. age-related changes in judgment and decision making*

processes, reward processing, social behavior (including trust, cooperation, competition, intergenerational exchange), and the performance of individuals in market economies.

The scenario-based CRP aims to inspire innovations for quality ageing that have a multi-disciplinary approach and coupled with a strong science base. As the ageing issue is complex and multi-faceted, it represents an opportunity for a holistic and integrative programme that combines biology, engineering, social behavioural sciences and economics. It is hoped that Singapore could become a world-class originator of innovative, aged-friendly technology, products and devices. The ageing issue requires the integration and strategic alignment of new technologies, personal responsibility and public policy.

ANNEX 3

Awarded CRP Proposals

Title: Biodegradable Cardiovascular Implants

Therapeutic cardiovascular devices that are able to deliver drugs and proteins locally constitute one of the fastest-growing segments of the medical device/drug delivery market, with innovations driven by innovations in biomaterials. In turn, such innovations rely on a better understanding of the biomaterial-biology interface and using this understanding to design new biomaterials. While biomaterials have been used as implants since the 1950s, the range of approved biomaterials to date has been limited, due mainly to a lack of understanding of the interactions of biomaterials with tissues which has impeded their wider application. Another factor is the lack of an interdisciplinary and a comprehensive “cradle to clinic” approach, with research seldom integrating doctors with scientists/engineers, extending from concept to human clinical trials.

This programme will bring together an interdisciplinary team of researchers and projects that will exploit a better understanding of implanted biomaterials systems – tissue interactions, to evolve viable therapeutic solutions to current medical problems. The programme seeks a better understanding of material-tissue, material-drug and drug-tissue interactions in cardiovascular applications. This will allow us to create new materials through surface and bulk modification as we better understand the cellular interactions. The new materials will also help develop better deployment systems for implants that can enhance control and efficacy over local drug/peptide/gene delivery.



Prof Freddy Boey
School of Materials Science & Engineering
Nanyang Technological University

Prof Boey's main research focus is in the novel development and use of Bio and Nano materials for more efficient biomedical implants, highly functionalised nanomaterials for energy and diagnostics applications, composite materials. He is currently Chair of the School of Material Science & Engineering, NTU. He has more than 200 publications and several patents licensed for commercial applications. His recent publications have been in Applied Physics Letters, Progress in Polymer Science, Progress in Materials Science, Biomaterials, J. Control Release, Small.(?)

Major Collaborators:

- Prof Teoh Swee Hin (BE, NUS)
- Dr Lynn Lim, MD (NUH, NUS)
- A/Prof James Yip (NUH, NUS)
- Dr Philip Wong, MD (NHC, SGH)
- Prof Law Sai Kit (SBS, NTU)
- Asst Prof Bjoern Neu (CBE, NTU)
- Asst Prof Tan Lay Poh (MSE, NTU)
- Asst Prof Joachim Loo Say Chye (MSE, NTU)

Overseas Collaborators:

- Joachim Kohn (Rutgers)
- Prof Marc Abadie (Montpellier)
- Prof Lenny Rome (Biological Chemistry, UCLA)
- Prof Subroto Chatterjee, MD (Johns Hopkins School of Medicine)
- Prof Horng Chen, MD (Cardiovascular Medicine, Mayo Clinic)

Title: Biologically-Inspired Design, Nano-Fabrication and Nano-Lubrication of MEMS, NEMS, and Micro-Mechanical Devices

The surfaces of mechanical components assume an important role in the performance of a machine more crucially when the size of the component is decreased. Smaller-sized components have much larger surface area-to-volume ratios as compared to bigger components and hence, surface forces and surface properties determine their performance and durability within the machines in which they run – this is especially so in miniature machines with components several micrometers in dimension. Therefore, the success of the next industrial revolution in the area of micro-electro-mechanical systems (MEMS), nano-electro-mechanical systems (NEMS) and any other small devices, such as those used in medical applications and possibly in future clean energy generation, will crucially depend upon the ingenious design of new surfaces.

Nature has provided us with many examples where surfaces have been tailored to perform specific roles in a wide range of flora and fauna. We aim to adopt Nature's solutions to design surfaces with unique texturing, chemical modifications and coatings, to be applied in micro- and nano-machines to attain specific surface properties required for successful long-term operation in the micro- and nano-worlds. This research brings together mechanical engineers, materials scientists, physicists and chemists to find an enabling solution to a multi-disciplinary problem and is poised to strengthen Singapore's effort in becoming a world-class centre for research and commercialisation of microsystems and medical devices.



Asst Prof Sujeet Sinha
Department of Mechanical Engineering
National University of Singapore

Asst Prof Sujeet Sinha joined the department of Mechanical Engineering, NUS, in 2001. Prior to this, he worked at the National Institute of Science and Technology (NIST), the National Institute of Advanced Industrial Science and Technology (AIST), and Imperial College.

Asst Prof Sujeet's current interests include inventing new coatings and surface modification technique using polymeric systems for micro/macro machines and studying biological materials for surface related applications. He has published more than 100 articles in international journals and conference proceedings. He is on the editorial board of three international journals and is currently chairing the 2nd International Conference on Advanced Tribology which will be held in Singapore in December 2008.

Co-Principal Investigators:

- Prof Seh-Chun Lim
- Assoc Prof Vincent BC Tan
- Assoc Prof Siak Piang Lim
- Dr Guangya Zhou
- Dr Kian Meng Lim

Collaborators:

- Prof Hugh Spikes
- Prof Kyung-Suk Kim
- Prof Sanjay K Biswas
- Prof Ernst Meyer
- Dr Jian Huei Choo
- Dr Nalam Satyanarayana

Title: Theory and Practice of Coding and Cryptography

Recent advancement in communication and computing technologies provides fascinating opportunities for online social networking, commercial activities, business transactions and government services over open computer and communications networks. Such developments are only possible if communications can be conducted in a secure and reliable way. The theory and practice of coding theory and cryptography underpin the provision of effective reliability and security for information communication, processing and storage. Theoretical and practical advances in the fields are therefore a key factor in facilitating the growth of information communications and information networks. Coding theory and cryptography are practical interdisciplinary research areas with a high strategic impact on the infocomm industry in Singapore and beyond, and on society as a whole.

This programme aims to develop theories, methods, techniques and tools in coding and cryptography that have direct applications to finance, defence, security and health industries that require reliable and secure communication and storage. The approach to be adopted will leverage on the synergies of various tools from mathematics and computer science, and build on the wealth of expertise and experience the team has accumulated in these fields.



Professor Ling San
School of Physical & Mathematical Sciences
Nanyang Technological University

Prof Ling San is Chair of the School of Physical & Mathematical Sciences at the Nanyang Technological University. Prof Ling obtained his PhD from the University of California, Berkeley. He is an established researcher with an international reputation in the application of algebraic and number-theoretic methods in coding theory and cryptography. He received the National Science Award (Team) in 2003 for his team's accomplishments in the application of finite fields, algebra and number theory to coding theory, cryptography, and low discrepancy sequences. He also received the Singapore Youth Award (Science and Technology) 2001, for his achievements in modular curves and Galois representations. Prof Ling has published more than 60 journal papers, a textbook and edited several conference proceedings. He is a series editor on coding and cryptography for World Scientific. He has served as programme committee members or chairs for various conferences, and was recently appointed General Chair of Asiacrypt 2010.

Co-Principal Investigators:

- Prof Chee Yeow Meng (NTU)
- Prof Wang Huaxiong (NTU)
- Prof Xing Chaoping (NTU)
- Dr Kees AS Immink (Turing Machines, Inc., The Netherlands)
- Dr Frederique Oggier (Research Center for Information Security, Japan)
- Prof Igor Shparlinski (Macquarie University, Australia)

Title: Towards Manufacturability of Carbon Nanotube-Based Printed Electronics

Printed electronics have huge market potential but lacks a printable semiconductor with high carrier mobility and stability. Current printable semiconductors are typically semiconducting polymers which have low mobility and stability. Single-walled carbon nanotubes (SWNTs) are carbon-based cylinders with nanometer-scale diameters. They have mobilities and stabilities far exceeding those of polymers. They are also superior to other inorganic nanowires in terms of solution-processability due to their compatible density with solvents and low inter-tube resistance. SWNTs are regarded to be ideal candidates for the transistor material of printed electronics.

However, present SWNT-based printed electronics cannot simultaneously meet three critical requirements: High mobility, on/off ratio and production yield. There are two main challenges. Current nanotube synthesis methods produce both metallic (*met*-) and semiconducting (*sem*-) SWNTs though only *sem*-SWNT is desired for the transistor; the *met*-SWNT degrades the transistor performance. Also, synthesised SWNTs are typically highly-entangled, but nanotubes possess outstanding mobility only along the tube axis. SWNT networks (SWNT*nets*) yield more reproducible devices than individual nanotubes, but network performance is degraded by the nanotube entanglement and misorientation, electronic heterogeneity and intertube resistance. For dramatic improvement in device performance and reproducibility, aligned *sem*-SWNT networks must be used in the transistors.

In this programme, we aim to develop superior SWNT*net*-based field-effect transistors (FETs) with high mobility, on/off ratio and yield for printed electronics using aligned *sem*-SWNT*net* patterns.



Prof Chan Bee Eng Mary
School of Chemical and Biomedical Engineering
Nanyang Technological University

Prof Chan is an associate professor at the School of Chemical and Biomedical Engineering at NTU. She obtained her Bachelors (Chemical Engineering) and PhD from NUS (1986) and MIT (1993) respectively. She worked in various technical management positions in Singapore and USA before joining NTU in 2001. She has published more than 75 peer-reviewed international journals and 15 patents/patent applications.

Co-Principal Investigators:

- Prof Chen Yuan (NTU)
- Prof Li Lain-Jong (NTU)
- Prof Li Changming (NTU)
- Prof Zhang Qing (NTU)
- Prof John A Rogers (University of Illinois (Urbana-Champaign), USA)
- Prof Paolo Lugli (Technical University Munich, Germany)

Collaborators:

- Dr Charles Wang (ST Microelectronics)
- Prof Paula Hammond (MIT, Mass, USA)
- Prof Dai Liming (Dayton University, Ohio, USA)
- Prof Ng Siu Choon (NTU)

ANNEX 4

National Research Foundation Competitive Research Programme Funding Scheme

International Evaluation Panel	
1.	Dr Rita Colwell (Chairman) Distinguished University Professor, University of Maryland College Park and Johns Hopkins University Bloomberg School of Public Health, USA (concurrently NRF Scientific Advisory Board Member)
2.	Dr Mary Clutter Former Assistant Director of the Biological Sciences Directorate, National Science Foundation, and Fellow of the American Association for the Advancement of Science, USA
3.	Prof James Foley Stephen Fleming Chair in Telecommunications and Professor, College of Computing, Georgia Institute of Technology, USA (concurrently NRF Scientific Advisory Board Member)
4.	Prof Dr Louis-François Pau Professor, RSM Erasmus University, Netherlands and Copenhagen Business School, Denmark (concurrently NRF Scientific Advisory Board Member)
5.	Dr Richard Roberts Chief Scientific Officer, New England Biolabs, USA Nobel Laureate in Medicine (1993)
6.	Mr Thomas Stagnaro President and Chief Executive Officer, Americas Biotech Distributor, USA
7.	Mr Peter Tan Founder and General Partner, JP Asia Capital Partners, Singapore
8.	Dr Richard Yen Founder and Managing Director, Ednovation Pte Ltd, Singapore