

## **SIP# 249 Round 2**

**Title:** Manufactured Construction

**Acronym:** MANUCON

**Submitted by:**

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** New Production Technologies

**Type of project:** R&D project, including technology demonstration (large scale)

**Summary:** The project aims to germinate an offsite manufacturing capacity within the construction industry. This entails developing new production technologies aimed at creating an Open Architecture Building System capable of producing new building components and complete modules.

**Expertise offered:** Knowledge of local industry (economics, technologies, materials, stakeholders, roleplayers, strengths and weaknesses)

**Previous FP involvement:** None

**Consortium status:** CSIR-wide (BE, MSM, Composites, NTC, NLC)

**Expertise sought:** Materials and construction manufacturers

**Related projects:** FP6

## **SIP# 276 Round 2**

**Title:** Macroporous biphasic calcium phosphate bioceramic scaffolds for enhanced osteoconduction and osteoinductio

**Acronym:** MBCPS

**Submitted by:**

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Materials

**Type of project:** Thematic network on specific research questions

**Summary:** We propose to investigate novel powder processing-based methods of increasing the surface area of macroporous biphasic calcium phosphate scaffolds to optimise the rate and extent of osteoconduction and osteoinduction in vivo. The ideal material composition (i.e. hydroxyapatite/?-tricalcium phosphate phase content ratio), grain size, sintering temperature, surface chemistry and surface area will be determined in vitro using both osteoblasts and osteoclasts. Pre-clinical and clinical trials will follow this optimisation. The ultimate aim of the project is to develop synthetic bone filler / substitute material with superior host-integration properties to those already commercially available.

**Expertise offered:** Based in South Africa, our expertise is in the design, synthesis and characterisation of macroporous biphasic bioceramic materials. We have already developed and commercialised a macroporous hydroxyapatite orbital implant (Eyeborn®), and seek collaborators on this project which will extend the application range of our materials and materials processes.

**Previous FP involvement:** None

**Consortium status:** No consortium formed as yet.

**Expertise sought:** Experts in in vitro, pre-clinical & clinical testing of synthetic bone substitute materials are sought.

**Related projects:** None

## **SIP# 294 Round 2**

**Title:** Diamonds in Synchrotrons

**Acronym:** DiamSynch

**Submitted by:**

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Materials

**Type of project:** R&D project, including technology demonstration (large scale)

**Summary:** This programme studies the solid state issues of low strain synthetic HPHT diamond using synchrotron generated X-ray surface and bulk characterisation techniques and also promotes the application of diamond as various X-ray beam optical elements. Several extreme properties of diamond suggest it may play a key role as a beam optical element in 3rd generation X-ray Sources as well as in the X-ray Free Electron Laser systems. The strain sensitivity of the study is in the region of  $1 \times 10^{-8}$  and the crystal quality has significantly large regions which have comparable residual strain, where the residual defects are only very few single dislocations. The role of the surface in determining the residual strain as well as the significance of surface and bulk properties in relation to X-ray beam processing is studied. The results of the study are used in a continual feedback process to the diamond synthesis programme. A related research programme investigates all-important issues of scientific diamond processing and mounting systems. Specific focus areas here are the achievement of atomic scale surface roughness, sophisticated morphologies, issues of strain induced by the mounting process and the behaviour of the material under high heat load.

**Expertise offered:** Wits University (The Particle Solid Interactions Group) has recognized pedigree in diamond physics, for the materials science issues of the diamond beam optical element. They own or have access to the appropriate characterisation facilities. They also have a recognized international competence in the scientific processing of diamond

**Previous FP involvement:** Yes

**Details of previous FP involvement:** NoRHDia - Novel radiation hard CVD-diamond detectors (JRA11)  
Spokesperson: E. Berdermann (GSI, Darmstadt)

**Consortium status:** Discussion and mutual consultation stage

**Expertise sought:** Lead Partner - ESRF X-ray characterisation (joint R&D), Element Six Technologies in Cuijk and Johannesburg (Diamond synthesis and processing), other synchrotrons and the major EU-FEL project.

**Related projects:** International bilateral cooperation  
South African national R&D programmes

## **SIP# 295 Round 2**

**Title:** Novel radiation hard CVD-diamond detectors

**Acronym:** NoRHDia

**Submitted by:**

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Materials

**Type of project:** R&D project, including technology demonstration (large scale)

**Summary:** This programme is to develop radiation hard diamond based radiation detectors. This will be used in environments where conventional detectors may fail due to the intensity of the radiation flux. The radiation hardness of diamond as well as its favourable electronic properties are key in this application. The R&D program involves many components, such as the synthesis of diamond of sufficient size and quality, the development of Ohmic and Schottky contacts for connection of the diamond to the external circuit the study of the interaction of charge carriers with the residual surface and bulk defects as well as the metal-diamond interface. The interaction of radiation damage with the electronic properties is also important.

**Expertise offered:** Wits University (The Particle Solid Interactions Group) has recognized pedigree in diamond physics, for the materials science issues of the diamond radiator. They own or have access to the appropriate characterisation facilities. They also have a recognized international competence in the scientific processing of diamond. Our agreed focus point contribution will be the contribution to the study of the electronic properties of diamond specifically the influence of strain distributions to the charge collection.

**Previous FP involvement:** None

**Details of previous FP involvement:** NoRHDia - Novel radiation hard CVD-diamond detectors (JRA11)

Spokesperson: E. Berdermann (GSI, Darmstadt)

**Consortium status:** The consortium exists as NoRHDia - Novel radiation hard CVD-diamond detectors (JRA11)

Spokesperson: E. Berdermann (GSI, Darmstadt)

**Expertise sought:** The idea is to be involved with this consortium

**Related projects:** International bilateral cooperation

South African national R&D programmes

## **SIP# 296 Round 2**

**Title:** Photon Emission in Crystalline Undulators

**Acronym:** NEST PECU

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Materials

**Type of project:** R&D project (small scale)

**Summary:** This programme exploits the new physics possibilities of strong fields and coherence that arise in the aligned incidence of extreme relativistic charged particles onto oriented crystals. The strong field aspect is the Lorentz boosted crystal field where a regime is achieved that causes virtual pairs to become real. The coherence aspect relates to specific crystal orientations where many thousands of scattering centres will participate coherently to the cross-section for any given process. Within the suite of themes in this program, we mention the study of the crystal undulator, as carried out recently at CERN. Here periodically deformed crystal potentials replicate undulator conditions as in the synchrotron generation of X-rays. The difference is that MeV range radiation is expected. Diamond is perhaps the only material where this phenomenon may be extended to encompass the concept of the Free Electron Laser, so that one could eventually realize a gamma-ray Laser, for the first time ever.

**Expertise offered:** Wits University (The Particle Solid Interactions Group) has recognized pedigree in diamond physics, for the materials science issues of the diamond beam optical element. They own or have access to the appropriate characterisation facilities. They also have a recognized international competence in the scientific processing of diamond

**Previous FP involvement:** Yes

**Details of previous FP involvement:** NoRHDia - Novel radiation hard CVD-diamond detectors (JRA11)

Spokesperson: E. Berdermann (GSI, Darmstadt)

**Consortium status:** Exists as the Fp6 NEST-PECU group

**Expertise sought:** Collaborate with this group

**Related projects:** South African national R&D programmes

## SIP# 309 Round 2

**Title:** Nano-electronic Devices Fabricated with Scanning Probe Microscopes

**Acronym:** NDFSPM

**Submitted by:**

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Nanosciences and nanotechnologies

**Type of project:** Implementation support to FP7s

**Summary:** Our project focus is the use of AFM lithography technique, to fabricate quantum channels and quantum dots with non-invasive detectors in close proximity. Electronic devices incorporating quantum dots and non-invasive detectors are currently amongst the few most promising candidates for experimental realization of quantum bits (qubits) which are the basic components of quantum computers. Using a biased conducting tip of an AFM in a humidity controlled ambient, patterns of oxide are written with a resolution better than 40 nm on surfaces of both metals and semiconducting materials. It is the electrical characteristics of these high resolution oxide lines that we exploit to pattern electronic devices at a nanometer scale. The quantum dots and detector devices will be fabricated on GaAs/AlGaAs materials grown using the MBE (Molecular Beam Epitaxy) technique by our research collaborators in the Semiconductor Physics Research Group at the Cavendish Laboratory, University of Cambridge in the United Kingdom. The device patterning and fabrication will be done at our laboratory in the Materials Research Group, iThemba LABS using the recently acquired AFM instrument. Low temperature electron transport measurements and characterization of devices will be carried out using cryogenic dilution refrigerator facilities (50 mK) at the Cavendish Laboratory. Our project collaborators will be Sir Michael Pepper of the University of Cambridge, Cavendish Laboratory in the UK, Professor Ricardo Garcia, Institute of Microelectronic Research, Spain, Madrid, and Professor C.T. Liang of the Department of Physics, National University of Taiwan in Taipei. It is our intention to later broaden the research scope of the project and use the availed resources to benefit some of our locally focused project portfolios. We, for example, intend to use the MBE-grown materials from the Cavendish Laboratory to perform a detailed study of the AFM-induced oxide composition using the RBS (Rutherford Backscattering Spectrometry) facility in our laboratory.

**Expertise offered:** Dr R. Nemetudi (SA) is an expert on AFM lithography which is the main device fabrication tool of the project. He has published widely on the technique, and has recently secured a DST-NRF grant to acquire the AFM which has since been installed at iThemba LABS. Professor Sir Michael Pepper (UK), a world expert in the field of low dimensional structures, is the head of Semiconductor Physics Research Group at the University of Cambridge. The group has unrivalled, world class MBE-growth expertise. The availability of good quality MBE-grown materials is critical for the project. Professor C.T. Liang (Taiwan) is an expert on electron transport measurements at cryogenic temperatures. He has published widely on electron transport in low dimensional electronic devices fabricated using split-gate technique. He has also worked with Dr Nemetudi measuring electron transport properties of devices fabricated with the AFM. Professor R. Garcia (Spain) is an expert on the growth kinetics of AFM-induced oxide lines, and has also published widely in the field.

**Previous FP involvement:** None

**Consortium status:** Several meetings have been held amongst the proposed participants to discuss optimizing the current and future impact of AFM on electronic device fabrication.

**Expertise sought:** Participants will have expertise in AFM lithography and electron transport measurements of low-dimensional electronic devices.

**Related projects:** International bilateral cooperation

## **SIP# 317 Round 2**

**Title:** Nano-explosive porous silicon devices

**Acronym:** NANEX

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**Theme:** Nanosciences, nanotechnologies, materials and new production technologies

**Focus Area:** Nanosciences and nanotechnologies

**Type of project:** Implementation support to FP7s

**Summary:** The idea is to develop porous silicon structures, impregnated with certain oxidants, and use the device as a nano-explosive detonator. The nano-explosive devices can be integrated with integrated circuit technology, to have the electronic timing and ignition circuit on the same chip as the nano-explosive device. Applications include spectroscopy, MEMS activation, security of systems, e.g. anti-tamper protection, and several others.

**Expertise offered:** Our expertise is in the etching of porous silicon and the impregnation of the porous layer with chemicals.

**Previous FP involvement:** None

**Consortium status:** We are looking for other universities to collaborate, or companies interested in the technology.

**Expertise sought:** We need expertise in the field of porous silicon growth, porous silicon characterization and knowledge of the explosive properties of materials.

**Related projects:** None