Centre for HRTEM at the NMMU

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In 1983 a committee of prominent South African scientists investigated the need for an advanced electron microscope facility in South Africa and identified a serious shortage in scientists skilled in the interpretation of advanced electron microscopy results. It was concluded that unless this problem was rectified, technological and academic developments in South Africa would be significantly hampered. Almost three decades later, on 11 October 2011, the first Centre for High Resolution Transmission Electron Microscopy (HRTEM) was launched at Nelson Mandela Metropolitan University (NMMU).

The establishment of the Centre was primarily funded by the Department of Science of Technology (DST), through the National Research Foundation (NRF). The National Research and Development Strategy identified the need to create centres and networks of excellence in science and technology as a key component of human capital development and economic growth. Additional funding was obtained from the Department of Higher Education and Training (DHET), Sasol, the NMMU trust, THRIP and Dr Greg Olsen (GHO Ventures, USA). A panel of international experts assisted the NRF and the NMMU with the selection of the most suitable HRTEM for the Centre.

The new Centre for HRTEM building is located on the NMMU South Campus in Port Elizabeth. The building took two years to design (2008-2009) and was influenced by a number of international Electron Microscope Centre designs and site visits to Europe. Special consideration needed to be taken to ensure that the building would meet the required specifications to allow the HRTEM to work at maximum proficiency. This included taking into consideration mechanical and acoustic vibrations, air pressure pulses, magnetic fields, stable electrical supply, air flow, air temperature, humidity and stable cooling water. The tender and building process commenced in 2010 and the practical completion of the building was achieved in April 2011.

The Centre houses a JEOL HRTEM and three other supporting state-of-the-art electron microscopes, as well as the complete enabling infrastructure for sample preparation and data processing. The gem of the Centre is the JEOL JEM-ARM 200F double aberration corrected HRTEM. With a resolution of 0.08 nm, the JEOL ARM can image and chemically analyse materials down to the atomic scale - a feat previously unattainable in South Africa. The Centre for HRTEM has become a leading global facility in materials characterisation on the nano- and atomic scale. It collaborates with research institutions across the world and in South Africa.

The significance of the nano- and atomic scale electron microscopy research covers a wide range of key technologies from identifying single iron atoms in graphene to obtaining information that could improve the safety of future nuclear reactors and extend the life of diamond drill bit inserts in oil drills. With the HRTEM it was possible to solve problems that have been mysteries to international researchers for many decades, e.g. the release mechanism of radioactive silver in pebble bed type reactors, the phase of a specific platinum-silver alloy and the thermal degradation mechanism of diamond drill bit inserts. Atomic resolution imaging has also provided important new information on nanoparticle catalysts, platelets in natural diamond, steel exposed to high temperature and stress conditions in coal fired power plants and radiation damage in oxide dispersion strengthened steel and silicon carbide.

JEOL JEM-ARM 200F double Cs corrected HRTEM

The Centre has already generated an impressive number of publications in a wide range of journals such as Nature Communications, Nano Letters, Journal of Nuclear Materials, Minerals Engineering and Nuclear Engineering and Design.

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