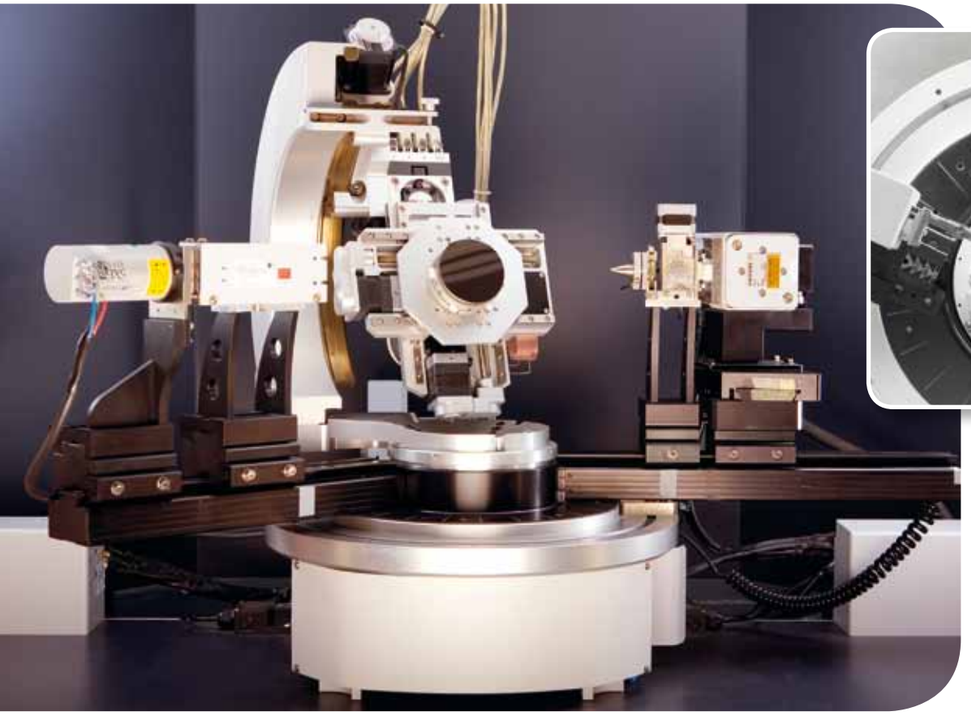
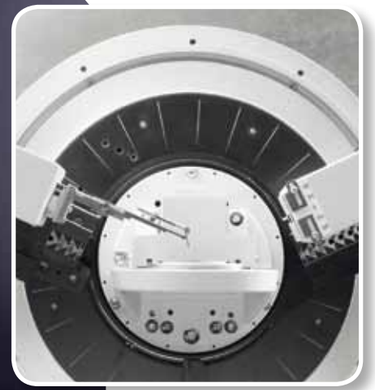




Formidable analytical tools at iThemba LABS include (left, above) the X-Ray diffractometer for directly identifying any crystalline material based on its unique crystal structure and (opposite) the nuclear microprobe used for PIXE (proton-induced-X-ray-emission).

DRIVING AFRICA'S NANO FUTURE

High-tech nanoscience and nanotechnology hold the promise of low-cost solutions to pressing socio-economic problems related to health, water and energy

Smaller nanotech players like SA need to adapt and identify niche areas for research – Professor Malik Maaza, senior research scientist.

NANOTECHNOLOGY
PUBLIC ENGAGEMENT

Perhaps it's because nanoscience and nanotechnology seem so intimidatingly high-tech that Africa has been slow to embrace the idea wholeheartedly. Ironically, the nano-world holds the promise of solutions to developing countries' pressing socio-economic problems – at a modest cost.

Fortunately, South Africa's commitment to nano technologies and science – notably in the establishment of the continent's nanocentre – is being implemented at several locations, from Nelson Mandela Metropolitan University to Mintek, the CSIR and many others. Over the course of the next few months, we'll be exploring these, starting off with iThemba LABS near Cape Town.

iThemba LABS is the umbrella title for a group of multi-disciplinary research laboratories administered by the National Research Foundation, based at two sites in the Western Cape and Gauteng. The Western Cape facility, formerly a training ground for nuclear physicists and chemists, is home to a subatomic particle accelerator and research facility. It's the largest facility of its kind in Africa – in the Southern Hemisphere, in fact.

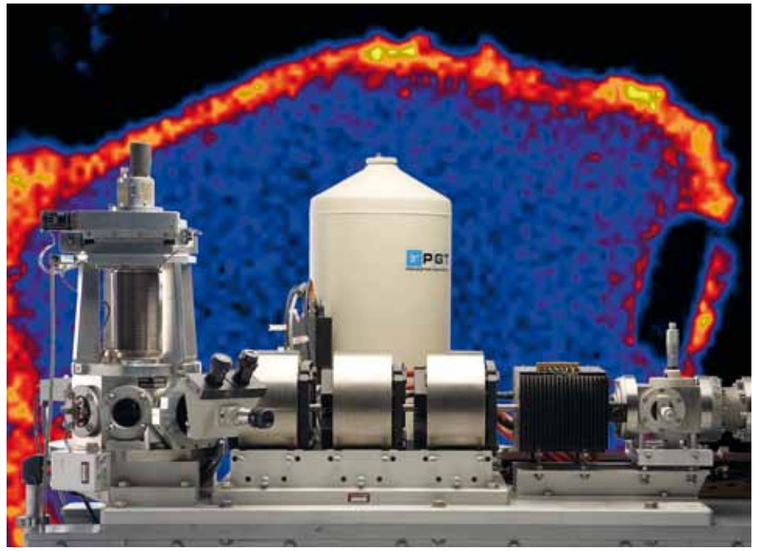
Nanoscience resides within iThemba LABS' materials research group. Researchers are involved with both branches of the field:

Nanotechnology: the ability to control material in the scale of 1 to 100 nanometres with the focus on their technological applications. At iThemba, this entails fabrication of nanomaterials via processes such as pulsed laser deposition, chemical procedures and nanorods.

Nanoscience: the study of materials at the nanoscale, and analysis of characteristics such as optical qualities, structure and morphology. Analysis includes surface interrogation using an atomic force microscope, study of the structure using an X-ray diffractometer and study of the optical properties using a spectrograph.

Part of everyday life

The thing is, nanoscale materials and technologies are not restricted to esoteric and limited uses. A case in point: the intelligent window.



Right: Researcher JB Kanakana grapples with the intricacies of thin film deposition. Below: Annealing furnaces produce temperatures up to 1 500 degrees.

Conventional window tints help limit heat transmission – but they also keep out natural light. A solution has been found that both allows free flow of light and regulates temperature. It's based on the fact that vanadium dioxide changes its characteristics in response to heat. Below a threshold temperature, the material is effectively a semiconductor, and allows light to pass through. Above that threshold, it rapidly morphs into a metal – simply put, when it's too hot outside, this specially treated window reflects heat. Essentially, it can do away with the need for air-conditioning by regulating temperature.

One obvious application is car windows. But, because of the vanadium oxide's relatively low cost (it's a by-product of mining, and is therefore freely available) there are potential benefits for ordinary householders exposed to the endless African sun.

Adding titanium dioxide to the mix enhances the effect: besides being a highly reflective white pigment of note, used in everything from food colouring to toothpaste and sunscreen, its photocatalytic property inhibits dirt from collecting and could even be used to generate electricity.

The way this type of coating reduces heat is that, although plenty of visible light gets through, infrared – heat-producing – radiation is reflected.

The technique, known as passive thermochromism because it needs no power and essentially alters its colour according to heat, is not particularly expensive. There's one ticklish problem to be overcome, though:, producing the correct 53-facet variant of the vanadium dioxide molecule that needs to be applied by vapour deposition as a coating can be tricky. That's where the researchers at iThemba have managed to develop a process for consistent, accurate production of the coating material in an economic way. There's enormous potential: currently they're in negotiations for the commercialisation of the product.

These kinds of materials are cooked up and analysed with the aid of some pretty formidable tools. For instance, their most recent acquisition is an X-ray diffractometer that hugely enhances their ability to study nanomaterials. This modern state-of-the-art equipment uses the only method able to directly identify any crystalline material based on its unique crystal structure.

There's also a laboratory for thin film deposition housing a high vacuum (HV) electron beam evaporator system with the capability to evaporate high melting point materials. Equipment on site allows multiple layers to be deposited on substrates, and annealing furnaces are available to induce reactions between a thin film layer and a substrate with temperatures up to 1500°C possible.

Centre for excellence

The nanocentre for Africa forms a vital part of South Africa's National Nanotechnology Strategy for harnessing nanoscience and nanotechnology to solve our social development issues. But there's a lot more to it than just research.

Its mission incorporates:

- Networking in Africa and beyond to facilitate integration of African programmes with international programmes.
- Marketing and communication with a focus on Africa's business sectors, and decision and policy makers.
- A commitment to human capital development.

Other initiatives in the fields of nanoscience and technology include a nanoscience centre at the University of the Western Cape, mainly focusing on the teaching of nanoscience, thus contributing to human capital development, and research chairs at several universities to strengthen research capacity in various areas of nanotechnology.

South Africa remains a small – albeit important – player in the nano-arena. That doesn't mean we can't make significant contributions, though. The thing to do is not necessarily to take on the big guns at their own game, but to operate smarter in a defined space. Says iThemba LABS' senior research scientist into nanosciences and materials, Professor Malik Maaza: "In the field of nano, one has to adapt... to ensure that you are reaching the right people. It's necessary to identify niche areas that the bigger players may regard as less of a priority." ●

NRF National Research Foundation | SAASTA South African Agency for Science and Technology Advancement

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