

quadrupolar order, in which the shape of the cerium atoms deforms in an alternating pattern across the crystal. In a magnetic field, the different shapes of the cerium atoms have different magnetic polarizabilities, so that in the presence of staggered quadrupolar order, a field induces a small antiferromagnetic density wave. This means that the Kondo breakdown observed in $\text{Ce}_3\text{Pd}_{20}\text{Si}_6$ is actually occurring without a total loss of magnetism. As a possible reason for this observation the authors propose that when the spin fluctuations weaken in higher-dimensional magnets such as $\text{Ce}_3\text{Pd}_{20}\text{Si}_6$, the 3D Kondo destruction phenomenon occurs within the magnetic phase.

Based on their results, the authors propose that dimensionality plays an intriguing role in heavy-fermion materials, suggesting a phase diagram in which the Kondo breakdown line moves as a function of dimensionality: in two dimensions, the line occurs simultaneously with magnetism, but in higher dimensions, it dives within the magnetic phase.

Although more measurements are needed to confirm the detailed interpretations of this experiment, the observation of Kondo destruction in a truly 3D heavy-fermion system deeply challenges our current understanding, making it clear that quantum criticality and dimensionality are more intertwined than we previously imagined. □

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MATERIALS RESEARCH IN AFRICA

Rising from the Falls

Materials science and technology could offer the opportunity to address vital needs of African people. But improving the infrastructure for science education and dissemination of knowledge is the first step to take.

Mohamed Chaker and Federico Rosei

With a GDP growing at a faster pace than East Asia's, Africa may be at the doorstep of an economic boom. Fuelled by revenues from natural resources and the rapid development of the manufacturing and service sectors, the continent has enjoyed a decade of steady growth, with forecasts pointing at a solid 6% for the next two years¹. Materials science can play a pivotal role² in a continued and sustainable growth, especially in areas such as water purification³, construction materials, solar-energy conversion, and nanotechnology for agriculture, food and health. The 6th International Conference of the Africa MRS, held at Victoria Falls, Zimbabwe, 11–16 December, 2011 (Fig. 1), offered the opportunity to discuss the latest advances in materials science and technology with symposia specifically tailored for Africa's pressing needs and challenges.

In this context, Wole Soboyejo (Princeton University, USA) reported a systematic approach to evaluate the mechanical properties and porosity of clay ceramics as a function of its constituent materials (that is, sawdust and clay). The final goal is to obtain optimized compositions for water-purification filters⁴.

Photovoltaics and materials for solar-energy conversion are a popular topic at the A-MRS conferences. In her



Figure 1 | Victoria Falls, Zimbabwe, backdrop of the 6th International Conference of the A-MRS.

plenary talk Sossina Haile (Caltech, USA) presented a thermochemical approach for converting H_2O and CO_2 into storable fuels using solar radiation. Because of its high catalytic activity and refractoriness,

cerium oxide rapidly produces H_2 or CO_2 and releases the adsorbed products on cycling the temperature. This represents a promising approach towards highly efficient solar cells⁵. In the photovoltaics

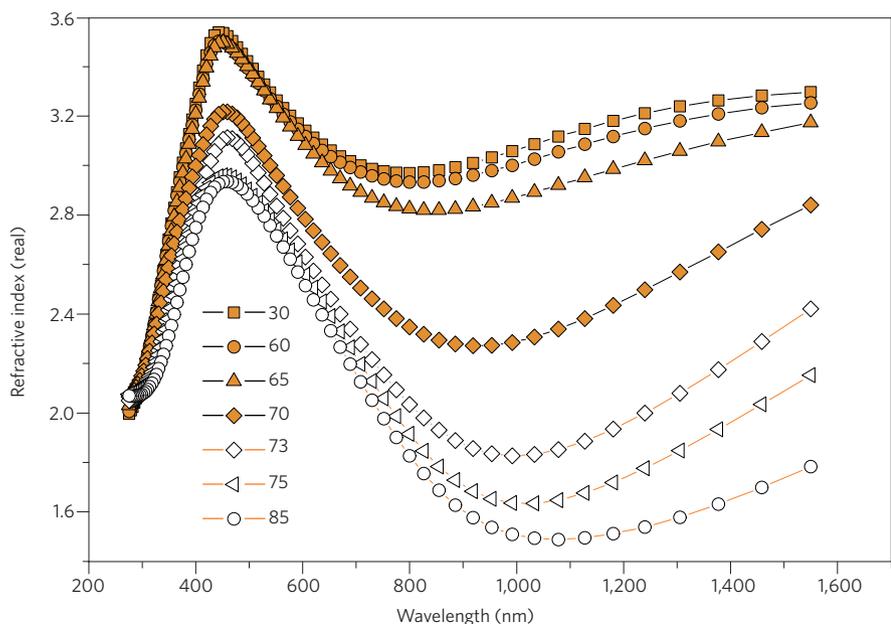


Figure 2 | Thermal modulation of the real part of the refractive index of a ~ 400 nm coating of VO_2 grown by laser ablation on a quartz substrate deduced from ellipsometry measurements at seven temperatures in the range 30–85 °C. Reproduced from ref. 6, © 2012 Elsevier.

session, Yohannes Teketel (University of Addis Ababa, Ethiopia) gave an invited talk on low-cost, scalable and facile fabrication of photoelectrochemical solar cells in which semiconducting conjugated polymers function as the active material. Zebastian Zana (SHESTCO, Nigeria) compared the performances of dye-sensitized solar cells fabricated with either a ruthenium dye or a yellow dye extracted from *Carica papaya* leaves. Although the conversion efficiency for the yellow dye is 0.12% (compared with 3.89% for the ruthenium dye), the study showed that readily available tropical ‘ingredients’ might be used to make solar cells at low cost.

Equally exciting were the presentations on materials for electronics and photonics. Malik Maaza (iThemba Labs, South Africa) presented the multifunctional properties of vanadium-oxide-coated thin films. He demonstrated their use in smart windows for heat modulation (for both houses and satellites), ultrafast optoelectronic gating and tunable femtosecond plasmonics. These applications exploit the metal–insulator transition of VO_2 , which couples with a reversible change of its refractive index under thermal stimulation (Fig. 2)⁶.

Biomedical materials were featured in a dedicated symposium. An interesting concept of composite hierarchical structures combining bioimaging and therapy was proposed by Naomi Matsuura (Sunnybrook Research Institute, Canada).

She described perfluorocarbon droplets stabilized by a fluorosurfactant, lipid or protein shell that can be used as contrast agents for MRI applications; embedded in the droplet, CdSe/ZnS quantum dots can serve as therapeutic agents for cancer therapy. An important therapeutic application of nanoparticles was shown by Daniel Obikwelu (University of Nigeria at Nsukka) for the activation of T-cells in the immune system to target breast-cancer.

These few examples illustrate the high quality of the conference and, despite the limited funding, the high level of African research output. However, even with the encouraging economic performances and the eagerness of African scientists to improve the quality of life on the continent, the technology gap remains daunting. To tackle this issue, capacity building — that is, creating new opportunities through education, particularly in science and engineering — is one of the immediate challenges that need to be addressed⁷. The topic was discussed in a dedicated session in which Hans-Ulrich Habermeier (MPI, Stuttgart) stressed the importance of research networking and the need for knowledge-based infrastructures. His view was supported by a cross-correlation between various indices such as human development, technology development and education, thus convincingly arguing how implementing existing technologies and diffusing innovation are economic driving forces for developing countries, a concept

that should become increasingly important in the agenda of local Governments.

Lesley Tobin (Institute of Nanotechnology, UK) introduced the international partnership Nano-network, a project funded by the European Union. A noteworthy initiative of the partnership is to provide wide access to the nanoscience literature through an open-access electronic archive of publications called Nano Archive (<http://www.nanoarchive.org>).

It is time to build on the scientific community that has gathered through the A-MRS conferences and form a well organized African society for materials research. Such a society should have enough human and materials resources to facilitate educational activities, regional workshops, more frequent international meetings, and collaboration and exchange of researchers; all essential requirements in training future generations of African scientists and engineers. An effective outreach programme would also be instrumental for promoting the impact of science and technology at the governmental level⁸. The hope is that local Governments and the African Union will be responsive and implement long-term scientific policies and funding programmes, including those to support international conferences. Other organizations with the future of African science at heart, such as the ICTP (<http://africa.ictp.it>) and the AIMS (<http://www.aims.ac.za>)⁹ are already providing valuable contributions and should continue to do so.

Finally, we hope that the success of this conference will convince more scientists of the African diaspora around the world to participate in future meetings and initiate collaborations with researchers based in Africa. Don't miss the next A-MRS meeting, to be held in Addis Ababa, Ethiopia in 2013. □

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