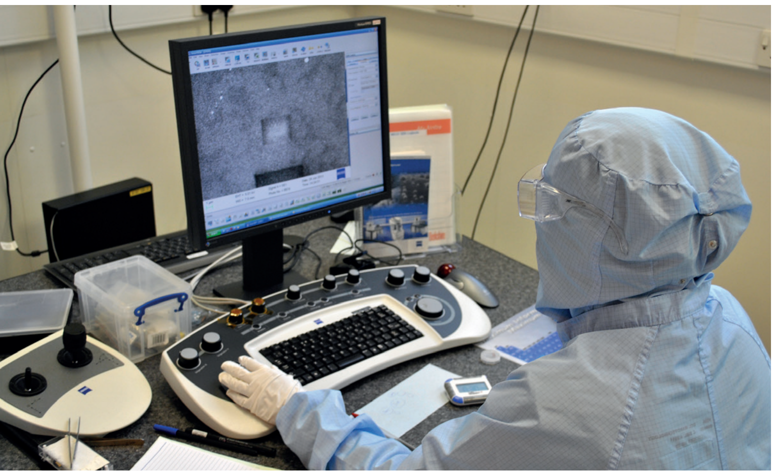
Small science for big innovations

Nicklaus Kruger reports from SA NanoSchool

Meeting the world's energy needs is a big challenge, but the solution may just lie in some small science: nanoscience.

"Energy consumption is rapidly increasing worldwide – and that, along with extreme exponential growth in the world's population, is resulting in a variety of challenges: global climate change, slowing economic growth, a lack of access to electricity for many people," said Prof. Ruud Schropp, Extraordinary Professor in Physics at the University of the Western Cape. "We need to meet our increasing energy needs in a sustainable way, and for that we need solar power. And for effective and efficient solar power, we need to employ nanoscience."



Prof. Schropp was speaking at the opening of the five-day South African Nanoscience and Nanotechnology Summer School, held in November 2019. In his talk 'Nanostructured thin films for multiband-gap silicon tandem and triple-stacked solar cells', Prof. Schropp noted that stabilising CO_2 emissions at a level that limits global warming to 2°C will require that at least a 14 TW renewable energy capacity be installed by the year 2050.

"If we were going to replace that amount of fossil energy by nuclear energy, we would need to build a power plant every two days, and that would come with some serious safety concerns," he said. "Other renewable power sources are promising, but don't scale as easily. It is clear that among the various renewable energy options, only solar energy offers ample resources to cover this demand."

Given the large scale needed, solar technologies that need to be developed should use naturally abundant and preferably non-toxic materials. Among the various

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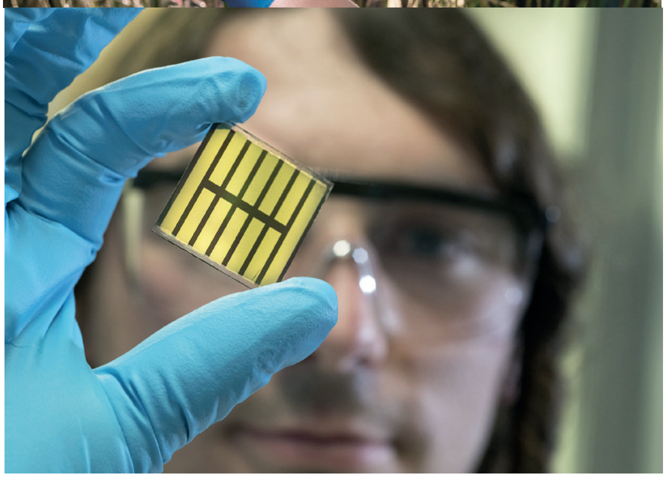

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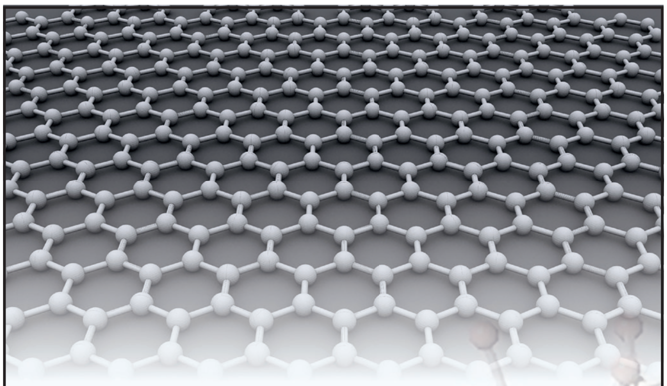
options available, silicon solar cells are dominating the market.

Even though silicon is the second most abundant element in the Earth's crust, the high purification that is needed and the indirect optical absorption make it an expensive source material. Therefore, further price reduction has to come from the use of thin films, the implementation of nanostructures, and the adoption of tandem solar cells utilising the full spectrum more efficiently.

"What we can do is try to make the best possible solar devices that will convince people to adopt solar power for their energy needs − devices that are cheap and efficient, and whose production is scalable," Prof. Schropp noted. "When it comes to solar panels, thinner is beautiful: the light doesn't have to travel as far, or through as much material, and that means less wasted energy."

As a source of energy, solar power is in ample supply. To meet the world's projected energy needs in 2050 using solar cells, we'd only need a few pieces of land: just 1.7% of the land area, globally speaking, would be sufficient.

"Renewable energy supply from solar cells can help build a sustainable society," said Prof. Schropp, "and further research can build technologies that are highly efficient and inexpensive, so that solar electricity will be abundantly available to everyone."



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The 5th South African Nanoscience and Nanotechnology Summer School, held in Stellenbosch on 25–29 November 2019, brought together 120 local and international industry experts, academics and postgraduate students to explore nanoscience matters on the theme, 'From research to applications, innovation and commercialisation'. Dubbed SA NanoSchool 2019, it was run by the Nanoscience Hub at the University of the Western Cape, which forms part of the National Nanoscience Postgraduate Teaching and Training Platform (NNPTTP), funded by the Department of Science and Innovation (DSI).

"Nanoscience can help us deal with many important issues: water purification, our energy and transport needs, biomedical and agriculture applications just waiting to be discovered and developed," says Prof. Dirk Knoesen, member of the SA NanoSchool 2019 organising committee and head of the NNPTTP.

Nanoscience is the study and development of materials at the nanometre size level (about 1/1000th the diameter of a human hair). This knowledge is applied in nanotechnology and the development of nanomaterials – materials with at least one external dimension in the size range from approximately 1–100 nanometres.

"The famed Fourth Industrial Revolution may be a digital revolution, but it has a physical basis in the materials that make a variety of products possible," says Prof. Knoesen. "For example, the very high speed computers of today, the huge increase in data storage and the extremely small devices (just about everything inside cellphones is nano-related), the fast biosensors that take a minute amount of blood to detect a variety of bio-based properties or viruses, etc. All of this is possible because of advancements in materials science, and especially nanoscience."

Funded by the DSI, the South African NanoSchools are designed to equip master's and PhD students with the necessary skills for conducting research in nanoscience and nanotechnology. They complement existing human capital development programmes in the field, and form one of many platforms for the implementation of the 2005 National Nanotechnology Strategy.

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