EASY SCIENCE

Sibo discovers Nano might be small but it is actually HUGE!

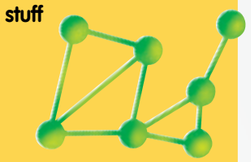
By Ginny Stone

Ever since my book on nanotechnology "Sibo Sizes Things Up", I've been interested in nano stuff. Eish! I never knew that it was all so interesting and that they were doing such amazingly cool stuff – right here in South Africa. Okay, the nitty gritty of how they actually do it is a bit too complicated for me to get my young head around, but I can tell you all about the end products. Those are things that we can relate to.

iThemba LABS

I discovered a place in Cape Town called iThemba LABS. Well… it's not really in Cape Town, it's about 20 km from Somerset West or Stellenbosch, but it's quite neat. iThemba means "hope" or "promise" and that makes sense because it's a place where lots of good work is done. The "LABS" stands for Laboratory for Accelerator Based Research. That's quite a mouthful. First, I thought it maybe had something to do with cars but nope, not even vaguely. They have special types of accelerators there that are used by scientists for different types of physics-based research. From nuclear medicine to cancer research, and there is a hospital as well, where they actually treat patients who have various types of cancer, using lots of specialised equipment with fancy names.

iThemba LABS is a big place where lots of different, exciting things are happening. I actually wanted to talk to you about some of the interesting stuff they are doing at the Materials Research Department that involves nanotechnology.



Nanotechnology

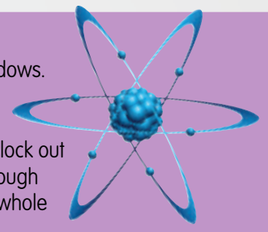
I know that's a long word and sounds pretty scary if you have not heard it before. *Nano* comes from the Greek word for dwarf. (You all know that a dwarf is a little person, right?) Imagine if you drank a magic potion that made you shrink, very, very small – smaller than anything you can think of. What's the smallest thing you can think of… ummm… a speck of dust? On the nanoscale that's huge! If you shrank by about 1 500 million times, instead of seeing normal stuff around you like tables, chairs, books, televisions – you would see atoms, molecules, proteins and cells. You would be seeing the atoms that everything is made from. Even better, imagine if you could move these around and you could put them together in new, interesting ways. Like tiny little building blocks of nature. Making new things on this teensy tiny scale is called nanotechnology. This is one of the most exciting areas of research today and many scientists are doing it, including scientists at iThemba LABS. They have a few different nano projects on the go. The actual details of how they do this research is just way too complicated to try and get our young minds around, but the end product is a lot easier to imagine and it's totally awesome.

Invisible aeroplanes

You know how in the movies (and in real life) there are aeroplanes, ships, submarines and other moving objects that can sneak in and out of places without being detected by radar? Well, this is where nanotechnology comes in. Radar absorbent material (RAM) is a class of materials that gets used in stealth technology, which even sounds sneaky, hey? This material coats the hot sections of turbine engines. Nanocerments get used in this material, and this is what scientists from the Materials Research Group are looking at.

Of course, there is nothing that can make a plane totally invisible, but radar absorbent material reduces or blocks radar signals that "bounce" off from the surface of planes. So, simply put, when the technical dudes on the ground look at the radar screen, they do see something, but it does not look like a plane. Pretty clever, I'd say.

Smart windows



They are also doing some research on smart windows. Imagine if you could just hit a switch and your window changed from clear to opaque (i.e. you can't see out and nobody can see in). You could block out some, or all, of the light that comes streaming through the window. Just think, not only could you save a whole lot of money on electricity, but you wouldn't need blinds or curtains either.

So how exactly would this save electricity? Firstly, when it's really hot in the summer and the sun's rays bake the room from the outside, making the air conditioning work overtime, smart windows could be used to block that extra heat. Sometimes people would like to have lots of windows for making a room nice and light, but then the room gets too hot. This way, you could block out the heat, but still have the light. And… by blocking UV radiation, smart windows can protect the stuff in your room too, like pictures and furniture. No more fading.

For years they have been using things called "Liquid Crystals", but now there is a new kid on the block called "electrochromics", using a plating of nano-structured zinc oxide.

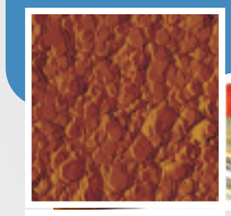
Let's go back to liquid crystals for a bit. You've all seen these in calculators, digital clocks, watches, microwave ovens. They use liquid crystal displays (LCDs). Electricity is used to change the shape of the liquid crystals to allow light to pass through, thereby forming figures and numbers on the display. The technology behind an LCD is similar to the polymer-dispersed liquid crystals used in some smart-window applications. With liquid crystals, the glass is either clear or dark – there is no in-between.

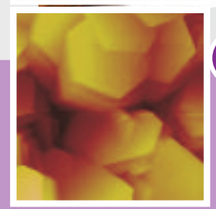
How Atomic Force Microscopy works.

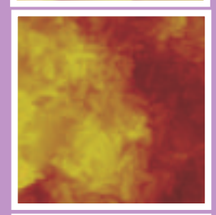
This is basically a special camera, pretty much like an ordinary optical camera, only that its process of getting an image is different. Whereas optical cameras generate images on the basis of light effects, an AFM uses an ultra-sharp needle, which is repeatedly scanned in close proximity with the surface.

It's a bit like sensing the surface of any piece of matter by feeling it gently with your finger. (Remember, the surfaces are way too small to feel with your finger). The AFM tip/needle traces the surface by slightly withdrawing from the surface whenever it goes over a bump, or advancing towards the surface whenever it encounters a dip. Since the tip can be atomically sharp, it is therefore possible to generate an AFM image at an atomic resolution (very, very small), something which optical-cameras are incapable of. In other words, this fancy machine can draw nano-pictures.

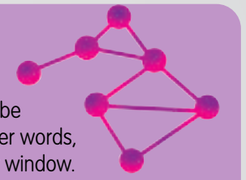
Thanks to the Head of the Materials Research Department – Dr Rudzani Nemutudi – who explained to me how the AFM worked and provided the cool pictures.







Easy Electricity



Electrochromic windows darken when electricity is added and are transparent when electricity is taken away – but here's the cool part – they can be adjusted to allow varying levels of visibility. In other words, YOU can control how much light comes into your window. Even better, you don't need to apply constant electricity to keep your windows tinted. You merely apply enough to make the change and then again when you want to reverse the change. Wow! On top of being able to pick and choose how light or dark you want your windows to be, this technique also uses less electricity than LCDs do.

Scientists are also having a look at the study of nano-photonics. This involves two broad themes:

- studying the novel properties of light at the nanometer scale, and
- enabling highly power-efficient devices for engineering applications.

This study has the potential to revolutionise the telecommunications industry by providing low power, high speed, interference-free devices, such as electro-optic and all-optical switches on a chip. Basically it means that things will go better and faster than ever before.

The scientists at the Materials Research Department have special equipment and use different techniques to study all this interesting stuff. Things like chemical techniques and electro-spinning. Plus they also use the Atomic Force Microscopy (AFM).

Can you figure how tall you are in nanometres?

If you want to cheat go to *http://nanozone.org/nanocalculator.htm* it will work it out for you.

Just to remind you how small nano really is…

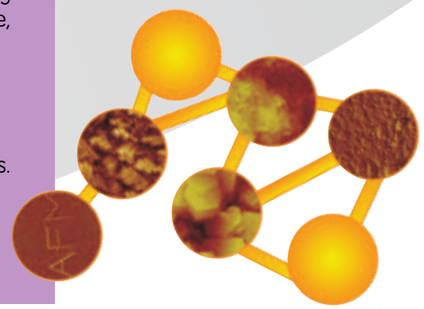
- A single strand of human hair is approximately 10 000 nanometres thick.
- A piece of normal office paper is about 100 000 nanometres thick.
- A kid 1.2 metres tall is 1200 million nanometres tall.

Give Away!

The first five people to send the correct answer to the question: "How thick is a normal piece of paper?", their name, age, telephone number and address to:

MiniMag / EasyScience 176
P. O. Box 72738
Lynnwood Ridge 0040

will receive one of the books – "Sibo Sizes Things Up!" published by *Lets Look Publishers*. Just make sure it gets to us before 15 May 2010!



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