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MediaTitle	Business Today		
Date	30 Dec 2016	Color	Full Color
Section	NEWS	Circulation	23,000
Page No	COV 1,28TO31	Readership	138,000
Language	English	ArticleSize	2616 cm²
Journalist	N/A	AdValue	RM 24,084
Frequency	Monthly	PR Value	RM 96,335

PEOPLE | SUCCESS | LIFESTYLE

BUSINESSTODAY

DECEMBER 2016 | volume 16 issue 12

With articles republished from FT FINANCIAL TIMES

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COVER STORY

Profits for The Future through Nanotechnology

An economic and social game-changer agency in the country, NanoMalaysia is all set to re-energise the country's economy through nanotechnologies. It is all about unlocking the potential of technology for profitable ventures.
- Dr. Rezal Khairi Ahmad, CEO NanoMalaysia Berhad.

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ISSN 1511-9408
RM10.40(WM) RM12.50(EM)
www.businesstoday.net.my
KDN-PP 11772/12/2012(031448)

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COVERstory

Dr. Rezal Khairi Ahmad, Chief Executive Officer of NanoMalaysia Berhad

There is a metaphor referred to as "splitting hairs" when a person argues the finest (and sometimes pointless) semantics of an issue, but as I found out one evening with the erudite and articulate Dr Rezal Khairi Ahmad, splitting hairs – specifically slicing and dicing a strand of hair 100,000 times – is the perfect way to demonstrate to a non-scientific person the depth and breadth of nanotechnology.

The subject matter might seem intimidating to the average layperson, we tell him guilelessly, and instead of giving us a laundry list of the basics of nanotech (that's what the cool kids refer to it as) he walks us through it all like a pro.

"Nanotechnology is about precision," he begins, without a trace of pomposity one might expect of a person immersed among some of the greatest minds in scientific discovery; specifically (since we are talking about precision) anything that can be included in nanotechnology is measured as being one billionth of a metre.

That's right. One billionth of a metre: that's what nano means in technical terms. Matter that tiny being manipulated skilfully: that's what nanotech is. The science and technology of small things, Rezal explains, given that the word nano is derived from the Greek word for dwarf.

"People ask why bother tackling small things when you can touch big things," he smiles, pre-empting our upcoming oppositional line of questioning. "Because it's all about precision." When you're able to manipulate matter at the atomic

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BY AMANDA SURIYA ARIFFIN

PROFITS FOR THE FUTURE THROUGH NANOTECHNOLOGY

An economic and social game-changer agency in the country, NanoMalaysia is all set to re-energise the country's economy through nanotechnologies. It is all about unlocking the potential of technology for profitable ventures

scale, you can "actually design your own matter," adds the 41-year-old.

PROFITABLE MANIPULATIONS & APPLICATIONS

Nanotech has some very viable and world-changing application. And, of course, profitable application. No-one is going to spend tens of millions of money just for love and sunshine.

The manipulation of atomic structures is being used in cosmetics, in materials, sporting goods, devices ("It's because of nanotech that our electronic devices have been shrinking in the last 30 years," he quips) and in the healthcare industry. It is when he talks about how nanotech can vastly improve the performance of the treatment of water – and even the desalination of sea water – or the extraction of a greenhouse gas, that things get quite interesting. Most harmful particles in public water reserves, he tells me, tend to be of nano-size.

He then employs the case of chemotherapy to further convince me of the effectiveness of nanotech: where chemotherapy is used to traditionally treat cancer (though there is controversy surrounding its efficacy in some quarters) Rezal explains that nanotech can help enhance cancer treatment so that a more targeted approach is done, possibly averting damage to healthy cells.

See, some of the common brickbats received from hardcore sceptics of nanotechnology revolve around the safety aspect: the bio-compatibility of applied nanotechnology.

"When nanotech is in vivo (that means when it involves and is in the human body) we have to be aware that certain nanoparticles are bio-compatible and some are not," he explains.

It is interesting that he says "have to" because the governance of the technology and the application of nano-innovation is a complex issue where one has to make sure academics, innovators, scientists, governments, legislators and future buyers of this technology (for profitable use included) are all on the same page. How many times has the public discovered the detrimental effects of a technology that was once lauded to change the world? Rezal admits that with any emerging technology there is always a certain level of public trepidation.

Comparatively speaking, when nanotech is used in public resources such as water treatment or in waste methane gas cracking, there is little interaction with the human body. Selective processes of careful assessment are conducted to determine which nanoparticles are bio-compatible, he says, adding that part of the reason he chose to study diamond nanostructure for his PhD is because diamonds are made of carbon, as is the human body, so the question of bio-compatibility is no longer a divisive one. Interestingly, Rezal is also currently exploring the bio-compatibility of nanoparticles from gold. This is why some consumers will see gold particles being used in some skincare products.

Due to the on-going evolution of research in nanotechnology, Dr. Rezal is confident that nanotechnology will have a long future in serving and meeting the needs of the public.

"This is why you can use things that contain gold on a nano-scale and your body will not react to it."

Isn't this technology potentially prohibitively expensive, though? "Not necessarily," he responds, "because you can synthesise gold." And yes, synthetic gold is, he adds, bio-compatible.

Some of the most common criticism he has heard revolve around cost, process and business overhauls and the ease of adoption. But as a former researcher, he understands, too, how researchers are perfectionists, therefore, researchers will never sit back in complacent satisfaction and think that this technology is done or that there is nothing more they can be improved on. Due to the on-going evolution of research in nanotechnology, he is confident that nanotechnology will have a long future in serving and meeting

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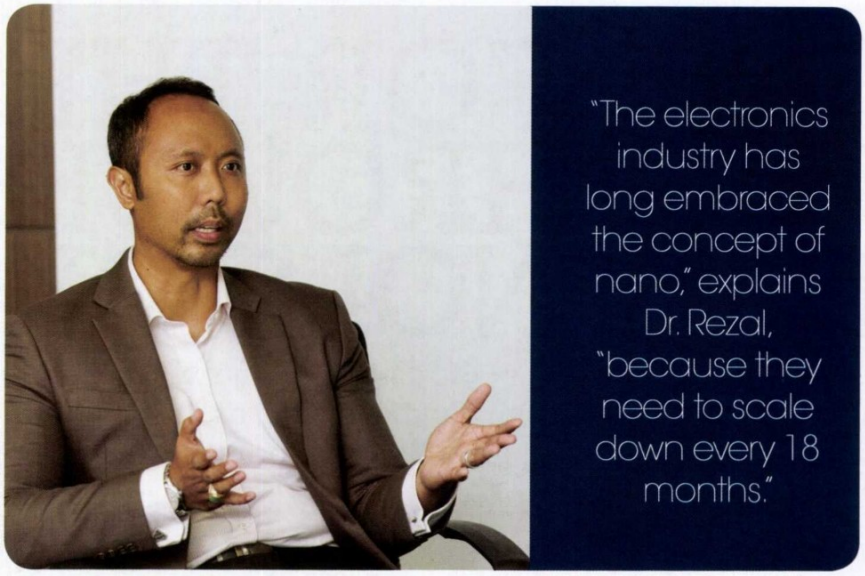

the needs of the country's sustainable economic growth and the public.

The nanotech industry in Malaysia prior to Rezal pursuing his PhD was still in its infancy. In 2009, three years after the Malaysian model of the States' National Nanotechnology Initiative was launched, nanotechnology was already in commercial use outside of Malaysia, for example, in chip processing for electronics.

"The electronics industry has long embraced the concept of nano," explains Rezal, "because they need to scale down every 18 months." This is Moore's Law, he says, where every 18 months everything in electronics is reduced in size by half. By now, we have reached the saturation point, he says, because we have reached the nano-scale.

What's beyond nano-scale? "Quantum mechanics," Rezal explains, like an excited school boy.

In case we weren't aware of it, Malaysia has, for the last 15 years, in its distinguished academic community, learned professors who are qualified to teach our budding Malaysian scientists the whole gamut of nanotechnology. Some of the foremost institutions leading the field in nanotechnology research – in addition to the Ministry of Science, Technology and Innovation (MOSTI), which is NanoMalaysia's "parent," as Rezal terms it – include Universiti Teknologi Malaysia (UTM), Universiti Kebangsaan Malaysia (UKM) and Universiti Teknologi Petronas, Universiti Sains Malaysia, Universiti Malaysia Perlis and MIMOS, among others.

The governance of these specialised research facilities in these institutions means they answer directly to the Vice-Chancellor or the CEO of that research facility. MOSTI has developed the framework of governance for nanotechnology, partly because nanotech is singled as one of the (many) pillars of the new economic model.

The National Nanotechnology Directorate was established in 2010, a division under MOSTI, that looks at the policy aspect of nanotech. This is important because unlegislated areas where atomic manipulation happens, can have ramifications. Think black markets and underground trade. The point becomes more acute when the worldwide nanotech industry was valued at one trillion USD last year. This is not child's play.

"Safety," says Rezal simply, is the topmost pressing concern for the layperson when the word nanotech is bounced around. "We have to choose the right type of nanomaterial, the right type of nanotech that is safe for public consumption, when we think about the commercialisation of nanotech."

MOSTI has been given the mandate and the resources to invest in long-term studies into the safety of nanotech. This runs concurrently, Rezal adds, with NanoMalaysia's efforts to bring the seeds of nanotech into commercial fruition.

CHANGING THE PLAYING FIELD

There are game-changing applications earmarked for the future, he elaborates, that include drug-delivery systems. From 2013 to 2016, six Malaysian scientists were shipped off twice a year to San Jose to learn from the collaborator IBM for these considerations, but the process of commercial realisation is a complex but rewarding one involving the highly-regulated pharmaceutical authorities and clinical trials.

It gets more exciting. "Nanoparticles can be employed as a super-thin coating on multiple surfaces in hospitals, which can destroy bacteria." This means patients and medical professionals can touch surfaces in the secure knowledge that it is all hygienic.

Isn't this a possible minefield of anxiety for traditional medical or pharmaceutical manufacturers, if nanotech can disrupt existing business models?

Dr. Rezal is balanced in his answer. "Yes, nanotech may disrupt the way you sell drugs or medicines or antibacterial gels and such, but if we license this technology to companies and they can piggyback their cargo of existing drugs onto nanotech as a delivery system, then you can deliver your drugs in a more efficient manner."

So if you were a pharmaceutical manufacturer, it wouldn't hurt your bottom-line if your drug took five minutes to kick in instead of an hour. That's what nanotech does: help things become better at what they're designed to do, as opposed to reinventing the wheel.

So how long will this technology serve its buyer? "With patenting, it should protect the licensing customer for at least 15 years," says Rezal.

But let's make this accessible to the everyday person, because corporations can indeed license this technology and make a lot of money from improving their products and services, but what of benefits to the rest of us?

Dr Rezal gives two very clear examples in a very scientifically-detailed exposition, which needs to be summarised for several reasons. In a nutshell, nanotech allows the manufacture of molecular sieves made from rice husks – of which we have plenty in supply – which consumes less

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energy in making water clean and safe for consumption. There are nanotechnologies already being developed that can speed up the desalination of saltwater into clean drinking water, and also by using less resources and energy.

WHAT ABOUT GRAPHENE?

As Dr Rezal shares more about the potential applications of nanotechnology, he talks about nanotech-produced bulletproof shields that are lighter and stronger than Kevlar, and of lighter, stronger de-icing coatings for aeroplanes made by nanotech using graphene. Nanotech can make condoms as thin as possible, he adds smilingly, "for obvious reasons." For now, the industry can conceive of medical gloves that are lighter, thinner and stronger yet impervious to all micro-organisms and piercing, but in the near future, we may see surgeons conducting non-invasive surgery using nano-robots for surgeries that traditionally required scalpels. "This is not science fiction," he proclaims; "It is a work in progress."

As he talks more about graphene, a nanoparticle discovered by two Russian scientists and taken from carbon that can, among other things, make rubber so strong that it can be taken beyond road use in tyres; we're talking using this rubber in outer space or under extreme conditions. Graphene, one atom thick and so strong that you'd have to balance an elephant on a pencil just to break it, has such revolutionary implications.

Dr Rezal also tells of how methane – a greenhouse gas – can be derived from industrial processes such as those involving palm oil mill effluents, and ultimately, nanotech can convert that methane into graphene; repeat this process and what you get is the ability to balance off the excess methane in the atmosphere. In a larger context, less global warming. You'd have to ask Rezal to explain it, for we could never do justice to his succinct explanation. Graphene captures carbon, as opposed to releasing it. Graphene can, if in the right hands, save the world.

He confidently proclaims, after a very lively discussion, that in three decades everything will be nano-tech. Currently, existing technologies such as bio-technology, green technology and ICT are undergoing nanotechnology adaptation evolving into nano-biotechnology, nano-green technology and nano-ICT.

Really? "Yes," he beams, "because we are collaborating with pre-existing technologies to simply making life better." Nanotech, he reiterates, can make use of existing materials that are in diminishing supply, to make things that allow us to do more with less. Altruistic? Perhaps. Profitable? Definitely.

"Yes, it's a multi-trillion market," concurs Rezal, "but it must be done right from day one. Malaysia can be a domestic champion, but we must remove ourselves from these shackles. The whole world is our market, and we can make ourselves a global champion of nanotech commercialisation." BT

NANOMALAYSIA™

NanoMalaysia is spearheading the National Graphene Action Plan 2020 programme

Nanotechnology began in the 1920s with a physicist by the name of Richard Feynman when he published an article about the available space between atoms and molecules. The term nanotechnology, however, wasn't coined until the 1970s in Japan. In the United States, nanotechnology made its grand public debut in 2001 when Bill Clinton recognised this powerful branch of science and launched the National Nanotechnology Initiative, intended to catalyse the industry in a top-down manner. Participation in nanotech in Malaysia were done sporadically at that time, admits Dr Rezal, but research groups in various universities had not been pulled together to collaborate even though academia was well aware of the wondrous potential of nanotech. Fast forward to 2006 when one of the founding directors of NanoMalaysia Berhad, Datuk Halimaton Hamdan, recognised the leveraging opportunities and proceeded to convince the Government of the immense value of nanotech. The Malaysian national initiative on nanotechnology was then launched in 2006 by the-then Deputy Prime Minister, Datuk Seri Najib Razak. It wasn't until 2009 that conversation about the commercial opportunities for nanotechnology in Malaysia was initiated. This was followed by the incorporation of NanoMalaysia Berhad in 2011 to consolidate and spearhead commercialisation activities in the country via the iNanovation programme, the National Graphene Action Plan 2020 and NANO*Verify* programme. BT