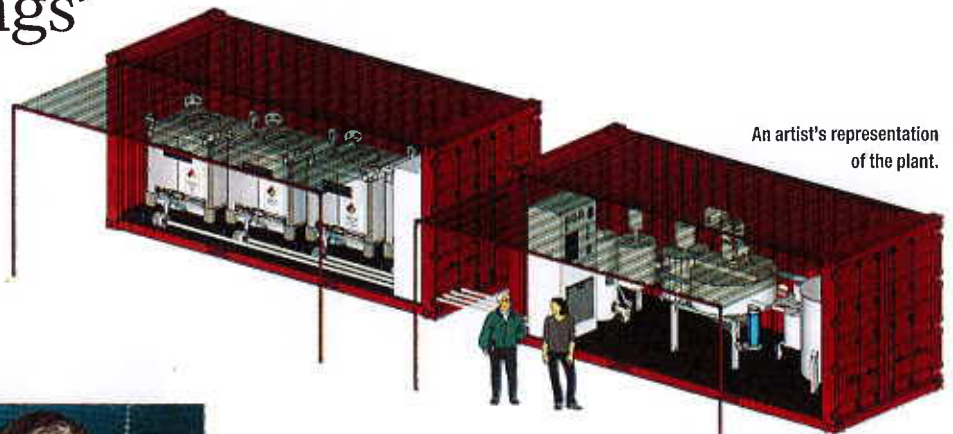


Graphene factory to put Aus at forefront of 'Internet of Things'

Australia's first graphene factory will open this year, and its owner believes it's cracked the code for making the nanomaterial useful. Brent Balinski reports on the new Imagine Intelligent Materials plant at Geelong.



It hasn't been done before

Though the Internet of Things has gotten a lot of people excited, we are nowhere near living in a world of things that communicate. Yet.

"I say 'the thing is a thing'," said Dr Phil Aitchison, chief operating officer at Imagine Intelligent Materials, tapping a chair to highlight his example.

"It's not a box of electronics. It's not a fridge; it's not a car. It's a thing: it's a table, it's a chair, it's a carpet fibre."

Dr Aitchison co-founded the graphene technology company (formerly NanoCarbon), excited by the material's potential to impact almost anything manufacturable.

Imagine IM has just announced that it will move from development to production, choosing Geelong as the site where it'll take its next step.

It believes it's found the killer app for exploiting graphene's famous, but as-yet unrealised, potential: industrial textiles and fibres. Allow a structure to sense and report when it's damaged or compromised and you'll do wonders for the safety of bridges, tailings dams and more. You could also make any other "thing" smart, if this was needed.

This would also mean you'll need a lot of graphene.

The company will set up its pilot plant - capacity roughly 10 tonnes a year - at the site of Austeng, with Austeng's help.

Austeng has diversified away from supplying the auto industry in the late-1980s, and has worked on everything from renewable energy to cremation systems.

"We define our business as



Ross George, managing director, Austeng.

engineering solutions or technology enabling," managing director Ross George told *Manufacturers' Monthly*.

"So we get a lot of customers come to us with ideas or some technology and our business is to turn that into nuts and bolts and pipes and valves and wires and control systems, to take their idea and actually turn it into a manufacturing facility."

Work in setting up a factory for Deakin University nanofibres spin-off Cytomatrix saw it highly recommended.

The new Cytomatrix factory involves taking a highly technical production method and industrialising it. The engineering challenges are vast.

"There are no textbooks that we can go and read, there are no websites, or very few. Every time we turn around we say 'I wonder what happens here' and we look at each other and talk to Imagine and everyone goes 'Hmm. We

really don't know, because it hasn't been done before,' said George.

"The challenges are trying to guess - for want of a better word - how the material is going to behave and what sort of flexibility we need to build into the machine to cater for all the things that we don't know about."

Production of graphene for geotextiles is scheduled to ramp up briskly after the pilot phase. Cytomatrix estimates output to be two tonnes this year, then five to seven tonnes next year, 15 - 20 tonnes in 2018 and 50 - 100 tonnes in 2019.

Shifting to advanced manufacturing

The presence of another high-technology manufacturer in Geelong is another step in the region's journey from traditional to newer industries.

Its Ford factory will shut in October this year, and great efforts - in state and federal grants, university collaboration programs and elsewhere - have been spent to prepare the region for a post-heavy industry future.

"Alcoa's gone and there are others under pressure - what it's meant is that to maintain the employment and the economy we've had to diversify," Rod Macdonald, Councillor at the City of Greater Geelong, told *Manufacturers' Monthly*.

"Obviously [graphene] is an industry that's going from the laboratory into a commercial state - this pilot plant is the first commercial plant in Australia that I'm aware of and I think it's terrific for Geelong to be at the

forefront of this technology."

Macdonald, as with many others, believes graphene is an industry that holds great growth potential.

He also cites Austeng as a "prime example" of what's happening in Geelong.

"And they're now finding out that their skills and the engineers they've got have been able to adapt and take on new projects," said the Councillor.

"I'm pretty excited for Geelong, with the industry that's emerging."

Other initiatives to help the local industry adapt include a recently announced state government "ManuFutures" hub (there are currently few details available on how or when this will operate), the Geelong Region Innovation and Investment Fund, and the state-of-the-art Carbon Nexus facility at Deakin University, Waurn Ponds.

Fit for purpose

Graphene, which has been hailed as a "wonder material" since it was first created in 2004 by two University of Manchester Physicists, is produced in many places. (These two Russian gentlemen later claimed the 2010 Nobel Prize in physics for their discovery.)

Just producing the atom-thin carbon layers is industrially meaningless, according to Imagine IM. In the way that "plastic" is a broad term that denotes many different types of materials with very different properties, "graphene" is a broad classification. The material needs to be

functionalised for specific purposes or its impressive properties won't be exploitable.

These properties include (in its purest form and at room temperature) being the most electrically conductive material known.

Making it at scale as well as functionalised to the point of usefulness have been chased by many, and have proven elusive. The facility at Austeng will be the first Australian graphene factory.

Getting to the point of manufacturing has required going "around the loop" many times, said Aitchison.

"We'll change the textile to one that is more appropriate for the application we're dealing with, and that requires different chemistry at our end," he said of one instance with a customer.

"We go back and close the loop again and change our recipe, because we're dealing with a slightly different material, and the properties of that material in interaction with our material are slightly different; go around the loop again. Any approval and

things need to be redone again."

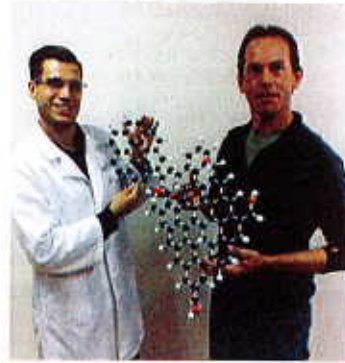
The company has found a recipe and an application coating geotextiles for a customer that it believes will be revolutionary, with both the partnership and initial field trials to be announced next month.

It'll be hoping the concept is developed and can build on initial successes.

"We can produce materials which are sensors for temperature, pressure, strain, water sensing: very simple sensors, but used in a way where it becomes ubiquitous," Dr Aitchison told *Manufacturers' Monthly*.

"It's not an expensive widget that needs to be wired up to a modem. It's not a complicated box of electronics. There are no batteries, there's nothing else. It's now sensing everything, everywhere.

"Pressure sensors? Put it in carpet and you've now got a security system. You've now got golf swing monitoring. You've got yoga mats. You've got - God knows - tree root detection. Are people sitting in



Vito Giorgio, product developer - composites, and Phil Aitchison, COO, Imagine IM.

seats? Are people moving enough?"

The idea of simple, graphene-based sensors is the sweet spot for the nanomaterial, according to the company.

"Disruptive technology doesn't need to be a standalone, brand new thing, whatever it is," co-founder Chris Gilbey told *Manufacturers' Monthly*.

"There's a huge amount of disruptive technology that is inherently

reliant upon a new infrastructure."

IIM and others involved in the new factory will be hoping to add to the number of new, successful high-tech manufacturing enterprises in Geelong, such as Waurin Ponds wheel maker Carbon Revolution.

The departure of old industries is always tough, but there's hope with what the future may hold.

Not everyone will agree, but it's been said that routine, low-variability, large-volume production, heavy industry, like that seen at Ford Australia, is a poor match for the Australian economy. The opposite - very small, even to the point of being one atom-thick - could be where success lies.

"The manufacturing that Australia has got to move into, in my view, is the special, boutique, bespoke, probably low-volume, high-value-add, unique, smart space," said George.

"And the graphene fits in with that, and obviously the machines that make the graphene fit in really well with that as well."

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