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Dr Alex Robinson Introduces Irresistible Materials

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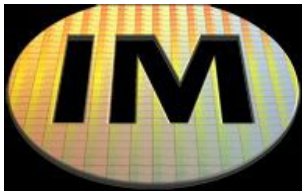

Dr Alex Robinson is a Senior Research Fellow of the Science City Research Alliance (SCRA) formed in 2009 between the Universities of Birmingham and Warwick. He is based in the School of Chemical Engineering at the University of Birmingham, with a visiting position in the School of Chemistry at the University of Warwick. He is a founder and Chief Technical Officer of Irresistible Materials – a UK based company formed to commercialise research in the areas of next generation resist materials for lithography and high aspect ratio etching of nanosized structures. Prior to joining SCRA he led the microfabrication group of the Nanoscale Physics Research Laboratory of the University of Birmingham. His PhD was undertaken at the University of Birmingham and the Joint Research Center for Atom Technology, National Institute for Advanced Interdisciplinary Research in Japan, under the supervision of Prof. R.E. Palmer (UoB), and Dr T. Kanayama (JRCAT, NAIR).

Irresistible Materials is a spinout company from the University of Birmingham that began operations in 2010 and aims to commercialise novel fullerene materials for applications in the semiconductor industry. It was formed by the entrepreneur and University of Birmingham alumnus David Ure together with the three academic founders: Alex Robinson, Professor Jon Preece, and Professor Richard Palmer, and the support of Alta Innovations with an initial focus on the fullerene based electron beam resist materials developed by Robinson, Palmer and Preece. Robinson's more recent inventions in the areas of extreme ultraviolet lithography resists and spin-on carbon for high resolution high aspect ratio etching are also now under development at the company. The company has successfully raised venture capital and now employs two researchers to drive this development work. It has formed a strategic alliance partnership with the fullerene manufacturer Nano-C in the USA to support the work and is developing relationships with a number of end users in the industrial and the academic communities to further the work.

What are your research activities?

My research is in the areas of lithography and etching for micro and nanofabrication. Over the past ten years I've led the development of molecular resists for electron beam and extreme ultraviolet lithography at the University, in collaboration with a number of companies including Rohm and Haas (Electronic Materials), Nano-C and Intel. This work has produced two distinct families of high-resolution chemically amplified resists, including the fullerene resist that is being commercialised (via the spinout Irresistible Materials). In addition to on-going work on resist development I am very interested in the microfabrication of novel structures and devices. Previous work has included the development of a material whose conductivity is altered by irradiation, allowing the direct creation of electronic elements via electron beam lithography without further processing, the production of coaxially shielded electron field emission devices, and the study of the preparation and patterning of silane and thiol self-assembled monolayers. Currently I am working on a new type of biosensor, investigating high aspect ratio ICP etching of nanostructures in both hard (e.g. silicon) and soft (e.g. silicone) materials, and fabricating surfaces to guide cell behaviour in biological systems. In addition to publications this work has led to 9 patents.

In what ways are you engaging with industry and how does this shape your research?

Most of my research topics are very applied and industry-oriented, but typically start out at a very early stage on the technology readiness level chart. The University environment allows me to look at very novel concepts that a company might not be able to take a risk on itself, but also provides opportunities to progress the work to quite an advanced stage. It is important to tailor your approach to industry appropriate to the project. It can take ten to twenty years to take a new invention to the stage where there is a marketable product and whilst companies regularly keep track of new developments they usually won't get involved at an early stage. It is therefore up to you to make sure you keep abreast of companies directions and priorities, for instance through industry roadmaps, attending industry-orientated conferences and developing good contacts at multiple companies. It is often very useful to get companies interested in collaborating on projects. This can range from just a letter of support (common), all the way to full funding (rare!). An interesting model that we are working with on one project is that we have invited a number of companies from various areas of the manufacturing chain to sit on an advisory panel for the project. Twice a year we get together and present the latest results and in return companies have given us a lot of insight in to what we, in their opinion should, be looking into and as the project progressed they have started to ask to trial our materials in their processes.

How do you think your research could impact on society? And what applications are there for your research?

It can often be difficult to link impact directly to the initial research ideas given the extremely long lag between invention and adoption. For instance the Laser, which was invented in 1960, was initially called a "solution looking for a problem" and it was almost fifteen years before they started to appear in consumers' lives and another ten before they were widely sold. Now the laser pervades virtually every sector of the economy from personal entertainment to healthcare. Even today, despite the apparent fast pace of technical innovation, it is still very much the case in the hardware world that it might be ten years or more before the idea you saw someone present at a conference becomes a device in something you can buy.

In my case I have been extremely lucky to have had the support from the University to take an idea – fullerene resists – from its initial conception in 1996 to the point where we have formed a spinout company and are talking to some of the biggest semiconductor companies in the world. The aim of that particular research is to support the continued miniaturisation of computer chips – known as "Moore's Law", which has seen computer performance double every eighteen months or so for the last forty years – past the point when conventional techniques will run out of steam through the development of new materials for use in various stages of the lithography process that is used to create computer chips.

More generally, whilst nanotechnology has often been overhyped and misunderstood (e.g. 'grey goo') its potential to enable advanced engineered materials which offer new properties that cannot be realised in any other way, such as metamaterials, biointerfaces, new catalysts, quantum effects, functional composites, and any number of other applications really cannot be overstated, and some really astonishing things are being created. The challenge will be to enable the transdisciplinary research teams across multiple schools and indeed colleges that will be required to undertake a lot of this work, and it has been good to see that RIS is increasingly working to bring disparate people together to enable these sorts of collaborations.

What support has the University provided in relation to KT activity?

Once you get close to the stage of publishing or presenting any data and certainly before interacting with companies (even in the very early stages), it is important to make sure that you have carefully considered intellectual property – whether you will need IPR protection or prefer to open source the idea. Some companies are only interested in ideas that are protected as well as proven, but surprisingly other companies prefer to see everything in the public domain, and may offer to fund research that is released without IP. This is one of the main stages at which Alta Innovations can provide a lot of support, particularly in the area of patent protection but also in market research and identifying potential exploitation routes. In our case we were given the time to further develop the ideas we had had after patenting them but in other cases it may be appropriate to look at licencing or spinning out immediately and Alta Innovations can advise on this, and indeed undertake the work to achieve either.

The other area where help from Alta Innovations is crucial is when you have taken an idea forward to the point at which it is ready to move from research in the University into development in an industrial environment. Once you start to commercialise an idea things can move frightening quickly (whilst often simultaneously being frustratingly slow!) and certainly in my case it was not long before I found myself in a very alien world of needing to raise finance, enter into contracts with end users and so on. Alta's help in forming the spin-out company, finding the people to run it, fund it and helping with contract negotiations with alliance partners, end users etc, has been absolutely invaluable, and certainly without the support we would not be where we are today.

What do you find most rewarding from KT activity?

Seeing the research from my group at the foundation of a small but growing company has been extremely satisfying. Each milestone we pass – forming the company, raising finance, taking on our first and then (this month) second employee, has been at least in some way a validation of the ideas we put into the company. Most gratifying of all has been the last year sitting down with serious people from multinational companies that want to invest their time and resources testing our solution to their manufacturing problem, and after much negotiation actually starting to send out samples.

Any advice for other academics?

The world of commercialisation and spinout companies is very different from anything that you might do in a University. It can be difficult going from your lab, where you are the expert, to sitting in front of a venture capitalist, or in a board meeting for instance, where you almost certainly aren't and it is important to recognise that. It is very helpful to have a good team of people who know what they are doing around you. Some of these will be from Alta, and others brought in for the spinout. It is very important to develop a good relationship with these people, as you will need to work very closely with them to succeed. If you are directly involved in the spinout, as for instance I am as the Technical Advisor for Irresistible Materials, do not underestimate how much time you will need to devote to the work. Sometimes it can feel like a full time job on top of your real full time job, and it can be very important both to manage your own time carefully, but also to manage the expectations of the entrepreneurs in the company who may well not realise that teaching and administration will not always allow you to focus continuously on the research, or the fact that you have other unrelated research projects.

To find out more about Irresistible Materials visit their website **www.irresistiblematerials.com (http://www.irresistiblematerials.com)**

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