Media Release

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HYPER DOTS: THE NEXT BREAKTHROUGH FOR BIO-IMAGING, DIAGNOSTICS, AND NANOMEDICINE

Researchers in the field of nanotechnology have discovered new tools that could change how cancers and brain diseases, such as dementia and Parkinson's disease are treated in the future.

The latest development in nanotechnology engineering has been discovered by Professor Dayong Jin from the University of Technology (UTS) and co-authors from the ARC Centre of Excellence for Nanoscale Biophotonics at Macquarie University, and collaborators from the University of Wollongong and the National University of Singapore.

Their discovery could form new solutions to getting around the body's immune system response in the targeted treatment of cancerous cells, which causes both the healthy and diseased cells to die.

"At this stage the treatment for cancer is applying radiation or chemical drugs which tends to be very aggressive," Professor Jin said. "You might kill the cancer cells, but you can also kill up to 70 to 90 per cent of the healthy cell.

"We see similar problems in the treatment of neurological diseases.There are a lot of drugs to treat these types of diseases, but the problem is the blood brain barrier which protects the brain from infections—a lot of the time the drug tends to circulate in the blood system and not the brain."

"We need to find a new vehicle for drug delivery that allows the healthy cell and blood brain barrier to recognise the drug as a 'friend' and not an 'enemy'."

Professor Jin's research is aimed at developing this new vehicle. Their latest breakthrough has seen a result of more than 800 synthesis experiments undertaken over the last three years by Macquarie University student Mr Deming Liu, who created a library of 800 different choices of new shaped nanocrystals formed from ordered atom clusters. The different shaped or 'hybrid' nanocrystals act as new tools, or a new molecular tag and a potential new vehicle for targeted drug delivery.

Professor Jin said the new type of nanocrystal could also lead to clearer diagnostic bio-imaging such as MRI scans and X-rays.

"Hybrid nanocrystals are multifunctional and able to simultaneously do different things at once. For example, you can design a super nanoparticle that has optical, magnetic and chemical responses which allows for multiple molality imaging of the disease and [eventually] super high resolution images.

"Having precise diagnostics is also important because when a surgeon operates they need to understand exactly where the tumour is," he said. "If higher resolution imaging is available, the

surgeon will be able to see a precise boundary between the healthy cell and tumour cell which will result in a better outcome for the patient."

Now that nanoparticles can be precisely controlled to create different shapes and sizes, researchers can begin to investigate whether the new type of nanoparticles have an impact on the transportation of drugs within the body.

"We already started investigating this problem, but the "life machine" is very complicated so we can say that we have the tool, but how to use that tool to do the right job we still don't know," Professor Jin explained.

The next phase of research will focus on further collaboration with medical researchers to tailor their design.

"As a tool provider we are quite confident, but we need to listen to the end users to know which tool we need to make," he said. "It's like we now have the manufacturing capability but we need to customise our design synthesis to be more aligned with the application."

This research was recently published in *Nature Communications* and can be viewed DOI: 10.1038/ncomms10254 (http://rdcu.be/fNbd).

Professor Dayong Jin is an ARC Future Fellow in biophotonics, nanotechnology & medical biotechnology at UTS Science. He is the Chief Investigator and Science Theme co-Leader at the ARC Centre of Excellence for Nanoscale Biophotonics; and Director of the recently established Initiative for Biomedical Materials & Devices (IBMD) at the School of Mathematical and Physical Sciences, UTS Science. Professor Jin was awarded the 2015 Eureka Prize with Professor Bradly Walsh CEO of Minomic International Ltd and Professor Tanya Monro from the University of South Australia for their invention of nanocrystals known as Super Dots which have the capability to "fish" a diseased cell from millions in a blood or urine sample.

Media contacts:

Rebecca Gallegos

T: 02 9514 8271 M: 0429 483 747 E: Rebecca.Gallegos@uts.edu.au

Tony Crawshaw

T: 02 9850 9545 M: 0402770403 E. Tony.Crawshaw@mq.edu.au