

MEDIA RELEASE

IBN Scientists Synthesize Gold to Shed Light on the Inner Workings of Cells - Breakthrough Promises to Revolutionize Disease Detection and Treatment



Red fluorescent gold nanoclusters can help to improve bioimaging and diagnostics.

Singapore, April 16, 2009 – Researchers from Singapore’s Institute of Bioengineering and Nanotechnology (IBN) have achieved another biomedical breakthrough with highly fluorescent gold nanoclusters for sub-cellular imaging. Their new invention has broad implications for biolabeling and disease diagnosis.

Measuring less than 1 nanometer in diameter, IBN’s gold clusters are much smaller than currently available nanoscale imaging technologies such as semiconducting quantum dots, which are usually at least 3 nanometers in size. Unlike quantum dots, the gold nanoclusters are suitable for use within the body as they do not contain toxic metals such as cadmium and lead. Their sub-nanometer size makes it easy to target the nucleus inside the cell for sub-cellular biolabeling and bioimaging. Tracking the cell nucleus can help scientists monitor the fundamental life processes of healthy DNA replication and any genomic changes. With improved bioimaging at the cell nucleus, scientists can also study the effectiveness of drug and gene therapies.

“Gold nanoclusters have promising characteristics for applications *in vivo*. Our materials are smaller, less toxic and more biocompatible than the existing inorganic fluorescent quantum dot tags. The red fluorescence of the nanoclusters enhances biomedical images of the body greatly as there is reduced background fluorescence and better tissue penetration,” said IBN Postdoctoral Fellow, Dr Jianping Xie.

Synthesized *via* a single-step reaction at body temperature (37°C), the gold nanoclusters are formed with

“Green” Environmentally Friendly Chemistry – The synthesis of the gold nanoclusters does not involve toxic chemicals or high temperatures. A single reaction with a protein is all that is required to produce scalable quantities of stable gold nanoclusters.

a commercially available common protein such as bovine serum albumin (BSA). “The protein holds and interacts with gold ions in aqueous solution. We are able to use this protein to provide a scaffold for the formation of gold nanoclusters,” explained Dr Yuangang Zheng, IBN Senior Research Scientist.

IBN’s gold nanoclusters are stable in aqueous solution as well as in the solid form, which facilitates their storage and distribution. Besides the low cost of the required reagents, the preparation of the gold nanoclusters also adopts an environmentally friendly method that does not involve toxic chemicals or high temperatures. In addition, the simple synthesis

technique can be scaled up easily for mass production. IBN’s research on gold nanoclusters

Sub-Cellular Access – IBN’s gold nanoclusters are less than 1 nanometer in size, allowing potential access to the nucleus inside the cell for biolabeling at the sub-cellular level. 1 nanometer is approximately 5 orders smaller than the breadth of a human hair (~10⁵ nm).

has been recently published in the leading international chemistry journal, *Journal of the American Chemical Society*, 131 (2009) 888-889.

“We are inspired by nature’s ability to create elegant and functional materials. Our process is similar to biomineralization in nature that is found in the formation of bones and shells: where functional proteins mostly interact with sequestered inorganic ions to provide scaffolds for mineral formation,” Principal Investigator and IBN Executive Director Professor Jackie Y. Ying elaborated. “There is a significant potential for our technology to impact biological and medical research, where our gold nanoclusters can significantly enhance the details available for precision bioimaging in medical diagnosis and treatment.”

Illustrations:



Fig. 1 Red fluorescence of BSA-Gold nanoclusters in aqueous solution and powder form under UV light.



Fig. 2 BSA-Gold nanoclusters in aqueous solution and powder under normal light.

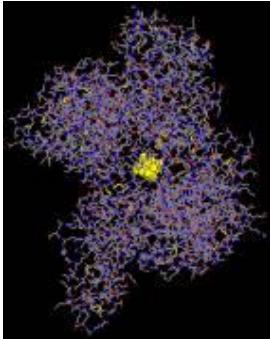


Fig. 3 Schematic diagram of BSA-Gold nanoclusters.

About the Institute of Bioengineering and Nanotechnology

The Institute of Bioengineering and Nanotechnology (IBN) was established in 2003 and is spearheaded by its Executive Director, Professor Jackie Yi Ru Ying, who has been on the Massachusetts Institute of Technology's Chemical Engineering faculty since 1992, and was among the youngest to be promoted to Professor in 2001. In 2008, Professor Ying was recognized as one of "One Hundred Engineers of the Modern Era" by the American Institute of Chemical Engineers for her groundbreaking work on nanostructured systems, nanoporous materials and host matrices for quantum dots and wires. Under her direction, IBN conducts research at the cutting-edge of bioengineering and nanotechnology. Its programs are geared towards linking multiple disciplines across all fields in engineering, science and medicine to produce research breakthroughs that will improve healthcare and our quality of life.

IBN's research activities are focused in the following areas:

- **Drug and Gene Delivery**, where the controlled release of therapeutics involve the use of functionalized polymers, hydrogels and biologics for targeting diseased cells and organs, and for responding to specific biological stimuli.
- **Cell and Tissue Engineering**, where biomimicking materials, stem cell technology, microfluidic systems and bioimaging tools are combined to develop novel approaches to regenerative medicine and artificial organs.
- **Biosensors and Biodevices**, which involve nanotechnology and microfabricated platforms for high-throughput biomarkers screening, automated biologics synthesis, and rapid disease diagnosis.
- **Pharmaceuticals Synthesis and Nanobiotechnology**, which encompasses the efficient catalytic synthesis of chiral pharmaceuticals, and new nanocomposite materials for sustainable technology and alternative energy generation.

IBN's innovative research is aimed at creating new knowledge and intellectual properties in the emerging fields of bioengineering and nanotechnology to attract top-notch researchers and business partners to Singapore. Since 2003, IBN researchers have produced a total of

490 papers published/in press, of which 223 were published in journals with impact factor greater than 3. IBN also plays an active role in technology transfer and spinning off companies, linking the research institute and industrial partners to other global institutions. As of March 2009, IBN has filed 692 patent applications on its inventions and the Institute is currently looking for partners for collaboration and commercialization of its portfolio of technologies. IBN's current staff strength stands at around 170 scientists, engineers and doctors. With its multinational and multidisciplinary research staff, the institute is geared towards generating new biomaterials, devices, systems, equipment and processes to boost Singapore's economy in the fast-growing biomedical sector.

IBN is also committed to nurturing young minds, and the institute acts as a training ground for PhD students and undergraduates. In October 2003, IBN initiated a Youth Research Program to open its doors to university students, as well as students and teachers from various secondary schools and junior colleges. It has since reached out to more than 28,900 students and teachers from 201 local and overseas schools and institutions.

For more information, please log on to www.ibn.a-star.edu.sg

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