MEDIA RELEASE

New Hydrogel from IBN and IBM Improves Delivery of Anti-Cancer Drug
Research breakthrough promises more efficient breast cancer treatment

Singapore, October 31, 2013 – The Institute of Bioengineering and Nanotechnology (IBN) and IBM Research (IBM) have developed a new non-toxic hydrogel that is capable of shrinking breast cancer tumors more rapidly than existing therapies. As described in their publication in Advanced Functional Materials, the Vitamin E-incorporated hydrogel can be easily injected under the skin without causing any inflammatory response, and releases anti-cancer drugs in a sustained manner over several weeks. This reduces the need for frequent drug administration, paving the way for the tumors to be eradicated in fewer treatments.

According to IBN Executive Director Professor Jackie Y. Ying, “Since 2003, IBN has adopted a multi-pronged approach toward cancer research. Our multidisciplinary research teams are working with various industrial, clinical and academic partners to develop new materials and tools to improve cancer diagnosis and treatment. This latest breakthrough with our long-term partner, IBM Research promises more efficient administration of anti-cancer drugs and more effective treatment of breast cancer, which we hope would benefit breast cancer patients worldwide.”

IBN Group Leader, Dr Yi Yan Yang, elaborated, “We have developed new, effective materials for nanomedicine, which has been one of IBN’s key research focus areas since 2003. The sustained delivery of Herceptin from our hydrogel provides greater anti-tumor efficacy and reduces injection frequency. Thus, our approach may help to improve patient compliance, offering a better alternative to existing breast cancer treatments. This technology can also be used to deliver other types of antibodies or proteins to treat different diseases.”

Breast cancer is the most common invasive cancer affecting women worldwide, including in Singapore. One in four breast cancer patients will have a significantly lower survival rate as they possess a particularly vicious type of cancer gene known as the human epidermal growth factor receptor 2 (HER2+), which causes rapid, unrestrained growth and division of cells in their breasts.

Herceptin, a US Food and Drug Administration approved therapeutic for the treatment of HER2+, helps to combat this type of cancer by regulating the cancer growth. Currently, this drug is administered intravenously in most clinics on a weekly basis, with each treatment session lasting 30 to 90 minutes. The need for frequent infusion of Herceptin and the accompanying discomfort may affect patient compliance adversely. Hence, the
IBN and IBM researchers aimed to reduce the number of injections and injection time required by creating a biocompatible, biodegradable and injectable hydrogel that can be conveniently injected into the body and release Herceptin in a sustained manner. Through this, they were able to reduce the frequency of drug administration from weekly to only once in four weeks.

Recent clinical trials using subcutaneous injection of Herceptin shortened the injection time to around 5 minutes and were reported to have comparable therapeutic efficacy as traditional methods at the same dosing schedule.

The new drug administration method via IBN’s and IBM’s hydrogel offers a further improvement on these studies as it supplies Herceptin continuously over a prolonged period of time. It also helped to shrink the tumors over fewer administrations. In animal studies with tumor-bearing mice, the tumors shrank in size by 77% 28 days after the Herceptin-loaded hydrogel was injected subcutaneously. The hydrogel did not evoke any chronic inflammatory response and degraded within 6 weeks post-administration.

“Drawing from our experience in materials innovation for electronics technology, we are now applying these techniques to the quest for improved health,” said Dr James Hedrick, Advanced Organic Materials Scientist, IBM Research – Almaden. “This hydrogel can help deliver drugs over an extended period of time without causing a significant immune response, effectively sending its contents directly to the tumor without harming healthy surrounding cells.”

The IBN and IBM scientists have filed a patent on their hydrogel technology and would like to engage pharmaceutical companies to further develop the hydrogel for future clinical applications. Specifically, the researchers would like to use their hydrogel formulation to deliver antibodies subcutaneously to improve disease treatment efficacy and patient compliance.

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Reference:


Images Available on Request:

![Figure 1: The IBN research team comprising Dr Yi Yan Yang, Dr Victor Ng, Dr Shujun Gao and Dr Ashlynn Lee (anti-clockwise from bottom right).](image-url)
Figure 2: Herceptin was loaded into Vitamin E gel by convenient mixing. The Herceptin-loaded hydrogel was tested in mice bearing breast cancer. Herceptin was preferably accumulated in the tumor tissues as compared to the healthy animal organs.

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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.

Professor Ying was a Professor of Chemical Engineering at the Massachusetts Institute of Technology (1992 – 2005). She was recognized as one of “One Hundred Engineers of the Modern Era” by the American Institute of Chemical Engineers in 2008 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 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:

- **Nanomedicine**, where functionalized polymers, hydrogels and biologics are developed as therapeutics and carriers for the controlled release and targeted delivery of therapeutics to diseased cells and organs.

- **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.

- **Biodevices and Diagnostics**, which involve nanotechnology and microfabricated platforms for high-throughput biomarker and drug screening, automated biologics synthesis, and rapid disease diagnosis.
- **Green Chemistry and Energy**, which encompass the green synthesis of chemicals and pharmaceuticals, catalytic conversion of biomass, utilization of carbon dioxide, and new nanocomposite materials for energy applications.

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 published over 890 papers in leading journals.

IBN also plays an active role in technology transfer and spinning off companies, linking the research institute and industrial partners to other global institutions. The Institute has a portfolio of over 620 patents/patent applications, and welcomes industrial and clinical partners to collaborate on and co-develop its technologies. IBN has successfully commercialized 50 patents/patent applications, and has established 7 spin-off companies.

IBN's current staff and students strength stands at over 155 scientists, engineers and medical doctors. With its multinational and multidisciplinary research staff, the institute is geared towards generating new biomaterials, devices, systems and processes to boost Singapore’s economy in the medical technology, pharmaceuticals, chemicals, consumer products and clean technology sectors.

IBN is also committed to nurturing young talents. Besides the training of PhD students, IBN has a Youth Research Program (YRP) for students and teachers from secondary schools, junior colleges, polytechnics, and universities. Since its inception in October 2003, YRP has reached out to more than 69,500 students and teachers from 290 local and overseas schools and institutions. Over 1,790 students and teachers have completed research attachments at IBN for a minimum period of four weeks.

For more information, visit www.ibn.a-star.edu.sg.