MEDIA RELEASE

Making Clothes from Sugar

IBN researchers have found a green and efficient method to produce nylon from sugar

Singapore, March 31, 2014 – In the future, the clothes you wear could be made from sugar. Researchers at the Institute of Bioengineering and Nanotechnology (IBN) have discovered a new chemical process that can convert adipic acid directly from sugar.

Adipic acid is an important chemical used to produce nylon for apparel and other everyday products like carpets, ropes and toothbrush bristles. Commercially, adipic acid is produced from petroleum-based chemicals through the nitric acid oxidation process, which emits large amounts of nitrous oxides, a major greenhouse gas that causes global warming.

IBN Executive Director Professor Jackie Y. Ying said, “In the face of growing environmental concerns over the use of fossil fuels and diminishing natural resources, there is an increasing need for a renewable source for energy and chemicals. We have designed a sustainable and environmentally friendly solution to convert sugar into adipic acid via our patented catalytic process technology.”

Bio-based adipic acid can be synthesized from mucic acid, which is oxidized from sugar; and the mucic acid can be obtained from fruit peels. Current processes are either performed using multiple steps with low product efficiency and yield, or under harsh reaction conditions using high-pressure hydrogen gas and strong acids, which are costly and unsafe.

The new chemical catalytic protocol designed by IBN is simple, efficient and green. To convert mucic acid to adipic acid, the target reaction is deoxydehydration, that is, oxygen and water will be removed simultaneously by reduction and dehydration. The researchers found that by combining deoxydehydration and the transfer hydrogenation reaction – adding an alcohol solvent – in one reactor, they could obtain a high yield of adipic acid at 99% of the starting material. Existing protocols can only achieve a yield of around 60%.

This method is ideal for industrial development because the process can be performed in one or two steps, the end product is pure, and the reaction conditions are mild and safe.

Dr Yugen Zhang, IBN Group Leader in green chemistry and energy said, “This work shows the tremendous potential of developing bio-based adipic acid. We are excited that our new protocol can efficiently convert adipic acid from sugar, bringing us one step...
closer toward industrialization. To complete this green technology, we are now working on using raw biomass as the feedstock.”

This finding was published recently in the leading Chemistry journal *Angewandte Chemie International Edition*. The work was funded by a grant from the A*STAR Science and Engineering Council to develop chemicals from biomass.

Dr Yugen Zhang’s group also holds patented technologies for converting other valuable chemical intermediates such as 5-hydroxymethylfurfural (HMF) and furfuraldicarboxylic acid (FDCA) from sugar. HMF is a key platform chemical that can be converted to biofuels and biochemicals, and FDCA can be used to make plastics and polyester. IBN seeks industrial collaborations to commercialize its portfolio of green technologies.

The IBN research team, who invented the new green chemistry method to turn sugar into adipic acid (from left) Dr Ting Lu, Dr Yugen Zhang, Dr Xiukai Li and Dr Guangshun Yi.

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About the Institute of Bioengineering and Nanotechnology

Established in 2003, the Institute of Bioengineering and Nanotechnology (IBN) is the world's first bioengineering and nanotechnology research institute. IBN's mission is to conduct multidisciplinary research across science, engineering, and medicine for breakthroughs to improve healthcare and 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.

**Scientific Impact**

- More than 930 papers published in leading scientific journals
- Over 1,000 seminars and presentations at international conferences, including over 650 invited, keynote and plenary lectures
- Organized premier scientific meetings such as the International Conference on Bioengineering and Nanotechnology, *Nano Today* Conference, and the IBN International Symposium

**Technological and Commercialization Impact**

- 505 active patents and patent applications
- 74 licensed patents and patent applications
- 7 spin-off companies
- 141 active research collaborations with industrial, clinical and academic partners

**Nurturing Future Research Talents**

- Trained 107 PhD students
- Over 70,300 students and teachers from 290 local and overseas schools/universities have participated in IBN’s Youth Research Program
- More than 1,800 students and teachers have completed research attachments at IBN

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