XLPE Recycled

Cross-linked polyethylene (XLPE) offers excellent thermal resistance whereas polyethylene alone is deficient, and is used as an insulating material for electrical power cables across a wide range of voltages from 600 V up to 500 kV. It is estimated that Japan alone generates more than 10,000 tons of XLPE waste a year. XLPE does not liquefy even when heated at high temperatures, nor does it melt when organic solvent is added to it, making it incapable of being heated and reshaped after it has been pulverized, and the recycling of this material is now becoming an issue.

Hitachi Cable has successfully developed a continuous processing technology that enables the low-cost recycling of sludge cross-linked polyethylene waste generated during the manufacture and disposal of power cables as an insulating material for power cables, along with electrical wire that uses XLPE. This was carried out by Hitachi Cable as a fundamental technology development project commissioned by the New Energy and Industrial Technology Development Organization (NEDO). It now hopes to develop practical applications for this technology as a material recycling method for XLPE waste, which up until now has mostly ended up being buried as landfill.

In XLPE, a cross-linking reaction gives the polyethylene a solid network structure where the cross-linking bonds between molecules make melting and molding difficult. Electrical wires produced from recycled cross-linked polyethylene, and the small spherical pellets (measuring around 5 mm) that are fed into the extruder.

In 2004, Hitachi Cable discovered a way to transform non-thermoplastic silane cross-linked polyethylene waste into suitable, formable thermoplastic polyethylene through the application of a supercritical alcohol to silane cross-linked polyethylene waste.

Conventional polymer processing, where a supercritical state is produced using the combination of a high-pressure pump and a reaction tube, requires pulverization of raw polymer into fine powder. In addition, this method also requires large quantities of solvents, making the processing of polymers a costly exercise. Hitachi Cable has developed a device that injects a supercritical alcohol into an extruder and then forms it into pellets designed to be directly fed into the extruder. This method only uses relatively small quantities of solvents, making it a low-cost alternative.

The electric wire prototypes produced by Hitachi Cable using the recycled XLPE are seen as being capable of use as insulating material, thanks to their mechanical and electrical properties. In the future, Hitachi Cable will promote research into the viability and safety of this trial equipment, with a view to developing practical applications.

Quantum Telecloning: Great Leaps Sideways

Quantum computers, capable of ultra-high-speed computation, could revolutionize the fields of conventional computers, work on a principle whereby quantum systems link quantum phenomena and atoms are entangled and used for computation. Quantum teleportation, the core technology at the heart of a quantum computer. A quantum computer, quantum state control acts like the CPU does in a conventional computer. Quantum teleportation is a technology whereby an approximate copy of quantum states of light is made and then transferred to two distant locations. Using this teleportation technology, we will be able to consolidate the process of transferring quantum teleportation and approximate copying (optimal cloning) into just one step, whereas previously these needed to be carried out as separate steps.

Professor Furuhashi Akira of the University of Tokyo was the first in the world to successfully test quantum teleportation, the core technology at the heart of a quantum computer. In a quantum computer, quantum state control acts like the CPU does in a conventional computer. Quantum teleportation is a technology whereby an approximate copy of quantum states of light is made and then transferred to two distant locations. Using this teleportation technology, we will be able to consolidate the process of transferring quantum teleportation and approximate copying (optimal cloning) into just one step, whereas previously these needed to be carried out as separate steps.

New Photocatalyst Soaks Up the Sun

The consumption of hydrogen, now being widely billed as the next-generation clean energy, is set to dramatically increase in the future, and as such, the effective production of hydrogen will be an energy issue in the years ahead.

In 1972, the production of hydrogen from water on a semiconductor via photocatalysis was discovered by Honda Ken-Ichi and Fujishima Akira for the first time, who demonstrated the decomposition of water using a photoelectrochemical cell consisting of a titanium dioxide (TiO2) electrode and a Pt counter electrode under UV illumination. The result was published in Nature, and is known as the "Honda-Fujishima Effect." Since this discovery, Japan went on to become the world leader in photocatalysis technology.

However, ultraviolet light only makes up a mere 3-4% of sunlight, and so there are great demands now for the development of a photocatalyst that utilizes visible light, converting more photons. It has been suggested that if practical applications for this technology can be developed, it could become one of the prime hydrogen production technologies for the future, as it will enable hydrogen to be produced directly from sunlight—an inexhaustible resource and water.

Furusawa has achieved two world firsts: namely his testing of deterministic quantum teleportation—the fundamental quantum entanglement control protocol—at the California Institute of Technology in 1998, and his successful transfer of the state of quantum entanglement in 2004.

In the current quantum teleportation experiments, he has managed to reproduce the quantum state of light at two locations with an accuracy of around 58%, which is almost 90% of the way to the theoretical limit for accuracy. While quantum teleportation between two parties has been previously reported around the world, there have been no successful cases to date on entanglement control between three quantum systems for teleportation. Furusawa explains, "If we are to realize quantum computers, we need to improve the performance of quantum teleportation, and to enable entanglement between multiple systems. In the future, we plan to work on boosting the track record of two consecutive quantum teleportations to four consecutive teleportations, and also plans to work on realizing entanglement between three quantum systems.

All stories by NOBU Magoon, University of Hawaii and Science/Culture type