Science and Technology

Innovations in conductive polymermaterials

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Background

Conductive polymers, which are plastics that conduct electricity, are known as the materials for which Professor Hideki Shirakawa was awarded the 2000 Nobel Prize for Chemistry. Our research team is working to bring to light functions of conductive polymers that have hitherto remain unexplored by other researchers, and to find applications for those functions in the fields of image and energy engineering.

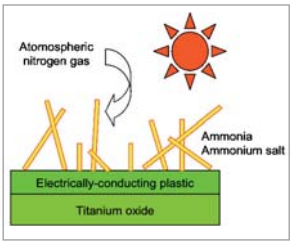
Results from this research

I will introduce two examples of our team's research. The first involves the application of conductive polymers to transparent conductive materials. When we brought metals into contact with certain kinds of conductive polymers that were green in color, we encountered a phenomenon in which the metal would be absorbed into the plastic whereupon both the conductive polymer and the metal would lose their color and become transparent. This transparent material inherited the properties of the original plastic, which meant that it had the ability to conduct electricity, and was soft and bendable (see Fig.1). Transparent materials which conduct electricity have hitherto been used in liquid crystal television displays, handheld game devices, and smartphone touch screens. Those materials however present certain drawbacks, in that their production requires the use of rare metals, and concerns have arisen over the future stability of supplies of those metals. In addition, because those materials are not bendable, they are not suitable for producing flexible TV displays or electronic paper, products which are likely to make their appearance in coming years.

We are also currently working on experiments to create inks out of these new transparent conductive materials.

A second example of our research involves the application of conductive polymers as materials for fixing atmospheric nitrogen. When conductive polymers and titanium oxide (the white pigment used in paints, printing inks, oil colors, crayons and so on) were pasted together and exposed to sunlight, a reaction was seen in which nitrogen gas in the atmosphere was changed in form to that of ammonia and a solid ammonium salt (see Fig. 2). Ammonia is the raw ingredient of fertilizers and various common chemical products, and ammonium salt is the rocket propellant used in the Space Shuttle. In other words our research can be described as having produced the basis of fuel and food stuffs out of air and light. This research has met with a major response, having been reported on the website of the U.K. science publication *Nature*, as well as by other publications including *Chemical & Engineering News* in the U.S. and *the Guardian* newspaper in the U.K.

▲ **Fig.1: Photograph of a transparent conductive sheet made from a plastic material**



▲ **Fig.2: How atmospheric nitrogen is fixed in this research**

Prospective developments

We envisage a day when the new materials and systems we have discovered will contribute to improving society through applications in new-generation image devices and energy systems.

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