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Versatile solvents offer hope for greener chemistry

Recycling of electronic scrap, lubricants for electric vehicles and perhaps eventually more energy-efficient light sources. Ionic liquids are versatile solvents with a number of promising applications. For Professor Anja Mudring and other chemists, ionic liquids present an opportunity to contribute to a more sustainable society.



Ionic liquids are versatile solvents with a number of promising applications, according to Anja Mudring. Photo: Niklas Björling

“Society faces major environmental challenges. We want to maintain our standard of living while minimizing our ecological footprint. Ionic liquids have an important role to play in achieving this goal,” says Anja Mudring, professor at the Department of Materials and Environmental Chemistry, Stockholm University.

Ionic liquids were discovered by chemists already in the early-20th century, but it is only during the last two decades that interest in these chemical substances has boomed internationally. The increasing focus on ionic liquids, both within academia and industry, is mainly due to the potential for using these liquids as a less harmful alternative to current solvents, which are often both detrimental to the environment and harmful to human health.

“Ionic liquids can be used as a replacement for flammable organic solvents. This is because ionic liquids have a very low vapor pressure, which means that they do not evaporate into the air and workers are not exposed to any toxic fumes.”

Researcher with merits from Germany and the US

In 2016, Anja Mudring was appointed to head the Physical Material Group at the Department of Materials and Environmental Chemistry at Stockholm University. By then she was already a distinguished researcher with merits from academia and research institutions in Germany as well as the US; in 2017, she received the Göran Gustafsson Prize for her work. Since her appointment, Anja Mudring has established and developed the research profile on ionic liquids at Stockholm University.

Among her numerous other achievements, she has managed to attract Robin Rogers, professor at the University of Alabama, to Stockholm. During 2019, he holds the Tage Erlander Guest Professorship at Stockholm University. Robin Rogers is involved in the development of a new environmentally friendly method of producing cellulose and viscose from marine and forestry waste.

“In Sweden, many applications of ionic liquids are related to cellulose. This is not so remarkable considering your large forest industry. But there are many other uses,” Professor Mudring explains.

Exploring ionic liquids as lubricants in electric vehicles

Anja Mudring herself works with both basic research and more applied projects. One example is e.g. a joint project between Stockholm University, KTH Royal Institute of Technology, Luleå University of Technology and the Swedish companies ABB and Nynas, exploring how ionic liquids can be used as lubricants in new electric vehicles.

The prolific Anja Mudring – she is the author of over 200 scientific papers – has also discovered that ionic liquids can respond to magnetic fields and show luminescence. In an ongoing project, with financial support from the Swedish Energy Agency, she is studying the use of such luminescent ionic liquids in producing an energy-efficient alternative to LED lights.

New processes for recycling valuable materials

During her time in the United States, Anja Mudring developed several environmentally friendly processes for recycling of valuable, currently critical materials, such as cobalt and rare earth metals, from old mobile phones and computers. The patented methods, which she developed together with two former colleagues at the Ames Laboratory (U.S. Department of Energy), recently received awards in American and international innovation competitions.

“Today, toxic chemicals are used to extract rare metals from electronic scrap. Our method uses ionic liquids based on ingredients that you can basically eat.”

Their versatility, and the fact that they can be modified for many different uses, is an important advantage of ionic liquids, says Anja Mudring. To produce such a fluid, you basically mix two different ions, which are also the components of ordinary table salt. This makes ionic liquids a safe - and also fun - topic to work with, she says.

“As a chemist, it is a pure joy to combine two components. There are an endless number of combinations that can be made. By playing with different salts in the lab, we hope to contribute to a better and more sustainable society!”

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