Scientific breakthrough can lead to cheaper and environmentally friendly solar cells

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The hope is to develop efficient and environmentally friendly solar energy applications. Solar energy is an inexhaustible resource that we currently only utilise to a very limited extent. Researchers around the world are therefore trying to find new and more efficient ways to use the energy in sunlight.

The technique the researchers in Lund are working on is solar cells consisting of a thin film of nanostructured titanium dioxide and a dye that captures solar energy. Today, the best solar cells of this type use dyes containing ruthenium metal - a very rare and expensive element.

"Many researchers have tried to replace ruthenium with iron, but without success. All previous attempts have resulted in molecules that convert light energy into heat instead of electrons, which is required for solar cells to generate electricity", says Villy Sundström, Professor of Chemical Physics at Lund University.

Researchers at the Chemistry Department in Lund, in collaboration with Uppsala University, have now successfully produced an iron-based dye that is capable of converting light into electrons with nearly 100 per cent efficiency.

"The advantage of using iron is that it is a common element in nature. It can provide inexpensive and environmentally friendly applications of solar energy in the future", says Kenneth Wärnmark, Professor of Organic Chemistry at Lund University.

By combining the experiments with advanced computer simulations, the researchers are able to understand in detail required design concepts for the iron molecules to work. This knowledge is now being used for further developing the iron-based dyes. More research is needed before the new solar cell dye can be used in practice, but there are high hopes.

"The results of the study suggest that solar cells based on these materials can be at least as effective as those of today that are based on ruthenium or other rare metals", says Villy Sundström.

The discovery could also advance research on solar fuels in which, like in photosynthesis of plants, water and carbon dioxide are turned into energy-rich molecules - solar fuel - with the help of sunlight.

"We envision that the new iron-based molecules could also drive the chemical reactions that create solar fuel", says Kenneth Wärnmark.

The researchers have worked on developing iron-based solar cell dyes for three years and are surprised by how quickly they found a dye that can capture sunlight as efficiently as this.

"Achieving success in research usually takes longer than what we hope for and believe", says Villy Sundström and continues: "For once, it was the opposite!".

The study, which has now been published in *Nature Chemistry*, is a collaboration between researchers from several divisions at Lund University, as well as researchers from Uppsala University.

More information: Iron sensitizer converts light to electrons with 92 % yield. *Nature Chemistry*, Published online 12 October 2015. DOI: 10.1038/nchem.2365

Provided by Lund University