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'Fool's gold' aids discovery of new options for cheap, benign solar energy

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The study of pyrite, or "fool's gold," led researchers at Oregon State University to the discovery of a new class of materials with promise for solar energy.

(PhysOrg.com) -- Pyrite, better known as "fool's gold," was familiar to the ancient Romans and has fooled prospectors for centuries – but has now helped researchers at Oregon State University discover related compounds that offer new, cheap and promising options for solar energy.

These new compounds, unlike some solar cell materials made from rare, expensive or toxic elements, would be benign and could be processed from some of the most abundant elements on Earth. Findings on them have been published in *Advanced Energy Materials*, a professional journal.

Iron pyrite itself has little value as a future solar energy compound, the scientists say, just as the brassy, yellow-toned mineral holds no value compared to the precious metal it resembles. But for more than 25 years it was known to have some desirable qualities that made it of interest for solar energy, and that spurred the recent research.

The results have been anything but foolish.

"We've known for a long time that pyrite was interesting for its solar properties, but that it didn't actually work," said Douglas Keszler, a distinguished professor of chemistry at OSU. "We didn't really know why, so we decided to take another look at it. In this process we've discovered some different materials that are similar to pyrite, with most of the advantages but none of the problems.

"There's still work to do in integrating these materials into actual solar cells," Keszler said. "But fundamentally, it's very promising. This is a completely new insight we got from studying fool's gold."

Pyrite was of interest early in the solar energy era because it had an enormous capacity to absorb solar energy, was abundant, and could be used in layers 2,000 times thinner than some of its competitors, such as silicon. However, it didn't effectively convert the solar energy into electricity.

In the new study, the researchers found out why. In the process of creating solar cells, which takes a substantial amount of heat, pyrite starts to decompose and forms products that prevent the creation of electricity.

Based on their new understanding of exactly what the problem was, the research team then sought and found compounds that had the same capabilities of pyrite but didn't decompose. One of them was iron silicon sulfide.

"Iron is about the cheapest element in the world to extract from nature, silicon is second, and sulfur is virtually free," Keszler said. "These compounds would be stable, safe, and would not decompose. There's nothing here that looks like a show-stopper in the creation of a new class of solar energy materials."

Work to continue the development of the materials and find even better ones in the same class will continue at the National Renewable Energy Laboratory in Colorado, which collaborated on this research.

The work was done at the Center for Inverse Design, a collaborative initiative of the College of Science and College of Engineering at OSU, formed two years ago with a $3 million grant from the U.S. Department of Energy. It was one of the new Energy Frontier Research Centers set up through a national, $777 million federal program to identify energy solutions for the future.

The OSU program is different from traditional science, in which the process often is to discover something and then look for a possible application. In this center, researchers start with an idea of what they want and then try to find the kind of materials, atomic structure or even construction methods it would take to achieve it.

Finding cheap, environmentally benign and more efficient materials for solar energy is necessary for the future growth of the industry, researchers said.

"The beauty of a material such as this is that it is abundant, would not cost much and might be able to produce high-efficiency solar cells," Keszler said. "That's just what we need for more broad use of solar energy."

Provided by Oregon State University

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