Cobalt and tungsten—the key to cheaper, cleaner hydrogen

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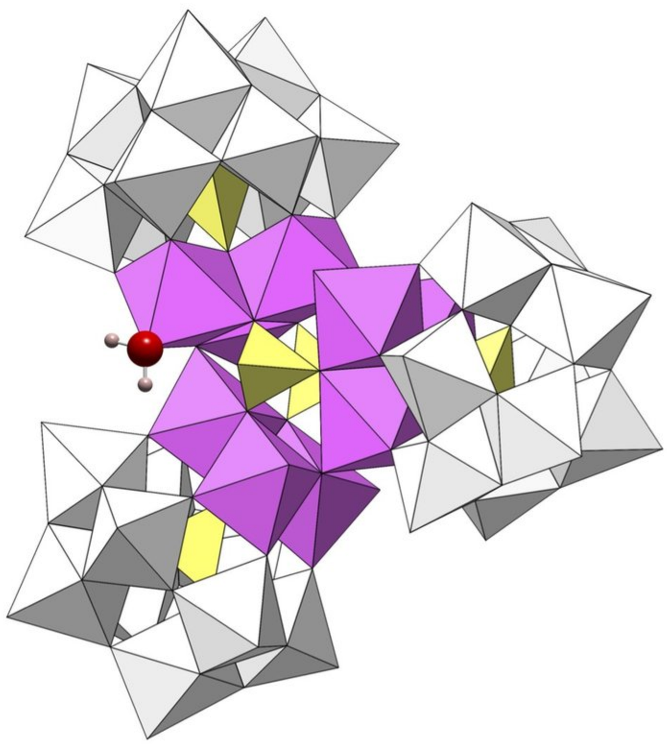

The new catalyst 'splits' water molecules to obtain hydrogen and oxygen with very low voltages. Credit: ICIQ

Electrolysis, splitting water molecules with electricity, is the cleanest way to obtain hydrogen, a clean and renewable fuel. Now, researchers at ICIQ and URV, led by Prof. José Ramón Galán-Mascarós, have designed a new catalyst that reduces the cost of electrolytic hydrogen production. Catalysts reduce the amount of electricity needed to break the chemical bonds, speed up the reaction and minimise energy waste.

"Normally, hydrogen is obtained from using a cheap process called steam reforming. But this is not clean hydrogen—this process uses natural gas and produces carbon dioxide and other contaminants," says Galán-Mascarós. "Breaking the water molecule is cleaner, but it's not easy. We need to develop cheap, efficient catalysts that allow us to obtain hydrogen at a competitive price," he says. To date, the best catalysts are based on iridium oxides, but iridium is a very expensive and scarce precious metal.

Chemists at ICIQ and URV discovered a compound made of cobalt and called a polyoxometalate that can catalyse water splitting better than iridium. "Polyoxometalates are nanometric molecular oxides that combine the best of two worlds: the activity of oxides and the versatility of molecules," explains Marta Blasco-Ahicart, postdoctoral researcher at ICIQ and first author of the *Nature Chemistry* paper. "Our polyoxometalates are way cheaper than iridium and allow us to work in acidic media, the optimal media to generate oxygen, normally a drawback for catalysts, which are usually consumed by the acid," says Blasco-Ahicart.

Joaquín Soriano, co-author of the paper and currently a postdoctoral researcher at Trinity College in Dublin, says, "Our catalysts work especially well when we work with low voltages. That may seem to be a drawback, but is actually an advantage. It saves electricity and will soon allow us to obtain the energy required for water splitting from renewable sources like solar panels."

The researchers present an additional discovery. When the catalysts are supported in a partially hydrophobic material, the efficiency of the process improves. This generates a "waterproof" reactor in which electrolysis advances quicker, and also enhances the lifetime of catalysts. The new methodology not only improves the performance of the new cobalt-tungsten polyoxometalates, but also a lot of other catalytic systems. Currently, researchers are investigating new ways of taking advantage of this finding, developing new hydrophobic scaffolds to further boost the efficiency of water splitting, a fundamental step toward the evolution of artificial photosynthesis.

More information: Marta Blasco-Ahicart et al, Polyoxometalate electrocatalysts based on earth-abundant metals for efficient water oxidation in acidic media, *Nature Chemistry* (2017). DOI: 10.1038/nchem.2874

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