How gold can recycle biofuel waste into useful additive

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Professor Alexey Pestryakov. Credit: Tomsk Polytechnic University (TPU)

Gold nanoparticles serve as catalysts for obtaining valuable chemical products based on glycerol. Scientists from Tomsk Polytechnic University and their international colleagues are developing gold

catalysts to recycle one of the main byproducts of biofuel production. The obtained products are in high demand in medicine, agriculture, the cosmetics industry and other sectors.

Scientists from the University of Milano (Italy), the National Autonomous University of Mexico, the Institute of Catalysis and Petrochemistry of Madrid (Spain) and the University of Porto (Portugal) took part in the study.

The research outcomes have been published in *Current Organic Synthesis* this May.

"Today the production of biofuels is an important area in many countries. They can be obtained from a great variety of biomasses. In Latin America, sources include orange and tangerine peel as well as banana skin. In the U.S., biofuels are produced from corn; in the central part of Russia and Europe, sources are derived from rape (Brassica napus). When processing these plants into biofuels, a large amount of glycerol is formed. Its esters constitute the basis of oils and fats. Glycerol is widely used in the cosmetics industry as an individual product. However, much more glycerol is obtained in the production of biofuels – many thousands of tons a year. As a result, unused glycerol merely becomes waste," says Alexey Pestryakov, the Head of the Department of Physical and Analytical Chemistry. "Now, a lot of research groups are engaged in this issue as to how to transform excess glycerol into other useful products. Along with our foreign colleagues, we offered catalysts based on gold nanoparticles."

The authors of the research note that catalytic oxidation on gold is one of the most effective techniques to obtain from glycerol such useful products as aldehydes, esters, carboxylic acids and other substances.

"All these substances are products of fine organic chemistry and are in

demand in a wide range of industries, particularly in the pharmaceutical and cosmetic industries. In agriculture, they are applied as part of different feed additives, veterinary drugs, fertilizers, plant treatment products, etc. Thus, unused glycerol after being processed will further be applied," says Alexey Pestryakov.

Gold catalysts are super active. They can enter into chemical reactions with other substances at room temperature (other catalysts need to be heated), in some cases, even under zero degrees. However, gold can be a catalyst only at the nanolevel.

"In a piece of gold, there will be no chemical reaction. In order to make gold become chemically active, the size of the particles should be less than two nanometers. At that scale, it has amazing properties," says the scientist.

"A great challenge in this area is that gold catalysts are very rapidly deactivated, not only during work, but even during storage. Our objective is to ensure their longer shelf life. It is also important to use oxygen as an oxidizer, since toxic and corrosive peroxide compounds are often used for such purposes," says Alexey Petryakov.

More information: Mario Farías et al. More Insights into Support and Preparation Method Effects in Gold Catalyzed Glycerol Oxidation, *Current Organic Synthesis* (2017). DOI: 10.2174/1570179413666161031114833

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