Making biodiesel with used cooking oil and a microwave

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Weaning cars and trucks off of gasoline and diesel made from fossil fuels is a difficult task. One promising solution involves biodiesel, which comes from natural oils and fats, but it is costly. Using a microwave and catalyst-coated beads, scientists have devised a new way to convert waste cooking oil into biodiesel that could make it more affordable. They report how they did it in ACS' journal *Energy & Fuels*.

Biodiesel has many advantages over traditional fuels. It is renewable, biodegradable and emits less carbon dioxide. It can also easily take the place of conventional diesel without the need for carmakers to modify engines. However, producing biodiesel at a low cost remains a challenge. Waste cooking oil is currently the most appealing source because it doesn't compete with the demand for virgin cooking oil. However, the process to convert it to fuel is complicated and expensive. Aharon Gedanken and colleagues wanted to find a simpler and less expensive method.

The researchers developed silica beads coated with a catalyst and added them to waste cooking oil. Then, they zapped the mixture with a modified microwave oven to spur the reaction of the beads with cooking oil. In just 10 seconds, nearly 100 percent of the oil was converted to fuel. The researchers could also easily recover the beads and reuse them at least 10 times with similar results.

More information: Alex Tangy et al. SiOBeads Decorated with SrO Nanoparticles for Biodiesel Production from Waste Cooking Oil Using

Microwave Irradiation, *Energy & Fuels* (2016). DOI: 10.1021/acs.energyfuels.6b00256

Abstract
Energy sources are necessary for human existence, comfort, and progress. Limited crude petroleum resources and increasing awareness of the environmental impacts of using fossil fuels motivate the search for new energy sources and alternate fuels. Herein, a low cost, fast, and green methodology for the synthesis of a hybrid solid base catalyst, strontium oxide coated millimetric silica beads (SrO@SiO2), is designed for the transesterification of cooking oil into biodiesel in a domestic microwave oven. The cost reduction is due to the effective utilization of the catalyst by the homogeneous dispersion of the active sites on the silica beads and their reusability. The catalyst synthesis process was optimized with respect to the amount of glass beads, microwave irradiation time, calcination time, and calcination temperature. Several methods for synthesizing SrO by minimizing energy consumption were investigated, and an optimized process for designing SrO@SiO2 was developed. The SrO@SiO2 catalyst produced under optimum conditions was characterized by TGA, XRD, FTIR, ICP, SEM, and TEM. XRD analysis indicated peaks typical of SrO alone. ICP analysis indicated 41.3 wt % deposition of SrO on silica beads. The novel solid base catalyst thus generated was used for the transesterification of waste cooking oil. Conversion values as high as 99.4 wt % in 10 s irradiation were observed from 1H NMR analysis using this composite catalyst, indicating the feasibility of economical biodiesel production from cooking oil waste in a very short time.

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