Nano World: Metal foams for catalysis

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Metal foams made of grains and pores only nanometers or billionths of a meter wide are lighter than Styrofoam, enough to float on water. The extraordinarily high surface areas these unprecedented foams possess suggest they could serve as excellent platforms for chemical reactions that for instance help generate electricity or remove pollutants, experts told UPI's Nano World.

The methods used for making metal foams have until now been limited mainly to a handful of metals such as aluminum. These produce relatively dense, heavy foams or low-density foams with large pores and low surface areas. The new and simple technique energetic materials chemist Bryce Tappan and a multidisciplinary team of his colleagues at Los Alamos National Laboratory in New Mexico developed produce unprecedented ultra-low density foams with pores as little as 10 nanometers wide from metals scientists could not foam in the past.

"This is the first time that both a practical and scalable process has become available for producing a variety of metal foams," said Dennis Wilson, founder, chairman of the board and chief technical officer at Nanotechnologies in Austin, Texas.

The scientists discovered their new method accidentally. They were investigating how pellets of metallic compounds rich in nitrogen burned. Normally such compounds combust very rapidly or even detonate. However, the researchers saw pellets burned rapidly but steadily when in an inert atmosphere. While the heated metal atoms attracted each other and ultimately coalesced into monoliths of nanoparticles, the resulting gases, such as hydrogen and nitrogen, blew tiny holes through the molten metal to form pores. The results are iron, copper, silver or cobalt foams.

Without the gases, "there would just be a pool of metal," Tappan said. Why the foams "don't fly apart into clusters or small particles is quite surprising," he added, and not quite understood at the molecular level. Tappan and his colleagues reported their findings in the Journal of the American Chemical Society.

These foams could find use in catalysts, the market for which in the year 2000 approached $27 billion in the United States alone. They could also find use in advanced chemical sensors for explosives and other harmful agents, Tappan said, in storing hydrogen fuel, or even as coatings for pellets in nuclear fusion experiments.

Membranes based on the porous foams could also find use in gas separation or water remediation, Wilson added. The foams might also be used in electrodes for batteries, fuel cells, solar cells or supercapacitors, he added. "The efficiency of an electrode relates to its surface area," Wilson explained, and these foams are high in surface area.

Future research can investigate into creating foams from other kinds of metals, as well as optimizing foams for applications by controlling their structures during manufacture, such as by tuning how much gas is generated or by tinkering with the levels and duration of the gas pressure during burning, Tappan said.