Lightweight Syntactic Foam Useful for Military Vehicles

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By: HDIAC Staff

Materials allowing for greater energy independence and fuel efficiency are of great interest to the Department of Defense (DoD). Advanced lightweight materials provide the ability to create lighter vehicles and are crucial to improving the performance of many systems in defense, energy and transportation. [1] Increased efficiency is crucial for the DoD, because increased fuel efficiency leads to fewer convoys and fewer warfighter losses. [1]

The Department of Energy is working to develop stronger and lighter materials for vehicles and the Defense Advanced Research Projects Agency's (DARPA) materials research led to developments in titanium and boron fiber. [1] Additionally, the Navy is interested in lightweight materials for various military applications. [2]

Because of the benefits of lightweight materials, lightweight foams – particularly lightweight syntactic foams – have attracted attention in recent years. While low-density foams are regularly used in commercial naval applications, materials for military use need to be more rugged to handle harsh military use. [2] Syntactic foam, which has a high crush strength and low density, could be an essential material for military applications. [2]

Syntactic foams, which can be made of metal, polymer, ceramic or glass, contain pre-formed hollow spheres as the main constituent. [3] The ordered structure of the hollow spheres provides compressive strength, but historically, these foams were limited by their lack of bending strength. The ability to bend without harming the structure is crucial for vehicle, airplane and military needs.

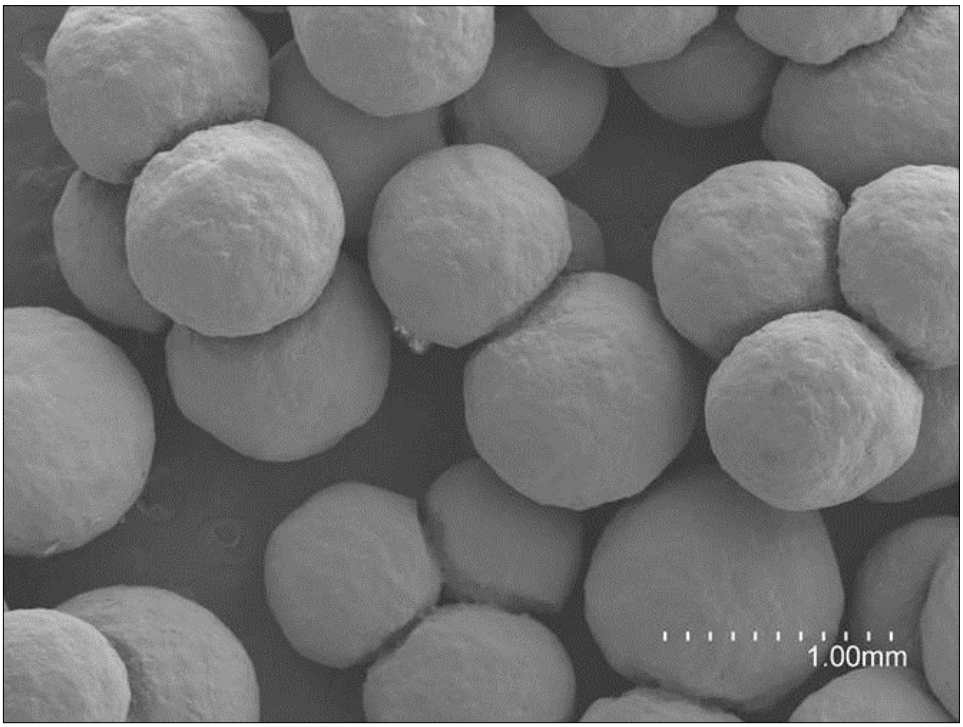

Image shows silicon carbide hollow spheres, a main constituent of syntactic foams. (Image courtesy of New York University)

Researchers with the New York University School of Engineering, Deep Springs Technology and the U.S. Army Research Laboratory are working to overcome the bendability issue so syntactic foams can be more easily used in a variety of applications. Previously, metal foams were sandwiched between stiff sheets to increase the strength and bendability. [4] But, the new research offers a way to increase stiffness and energy absorption while reducing the material's weight.

The researchers, led by Nikhil Gupta, tested a lightweight metal matrix syntactic foam core in a layered material. [4] The researchers report success in these tests and say the material is better able to hold its strength when bent or compressed. [4] The researchers focused on using an aluminum alloy filled with hollow alumina particles and sandwiched it between carbon fabric face -sheets. [4]

"This work could result in a new generation of ships and ground vehicles for both the military and civilian sectors," Gupta said. "Trains can also benefit from the lightweight and high energy absorbing panels made possible by the new sandwich composite." [4]

Gupta and his colleagues also developed a metal matrix syntactic foam core sandwich composite so light it can float on water. [5] This technology could be beneficial for amphibious vehicles being developed by the U.S. Marine Corps, such as the Ultra Heavy-lift Amphibious Connector, because they are light weight, highly buoyant and can withstand rigorous conditions. [5] Researchers

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expect these materials could be used in prototypes for testing within three years.

"This new development of very light metal matrix composites can swing the pendulum back in favor of metallic materials," Gupta said. "The ability of metals to withstand higher temperatures can be a huge advantage for these composites in engine and exhaust components, quite apart from structural parts." [5]

As development of lightweight materials continues, the military applications are limitless. Moving lightweight vehicles is more efficient than moving heavier vehicles. Lighter components means additional resources can be added. And lighter materials can be critical for alternative energy and medical technologies.

References:

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[3] CMT Materials. What is syntactic foam.

[4] Syntactic foam sandwich fills hunger for lightweight yet strong materials. (2015, July 16). Phys.org.

[5] New York University Polytechnic School of Engineering. (2015, May 12). A Metal Composite That Will (Literally) Float Your Boat.