New material could better protect soldiers, athletes and motorists

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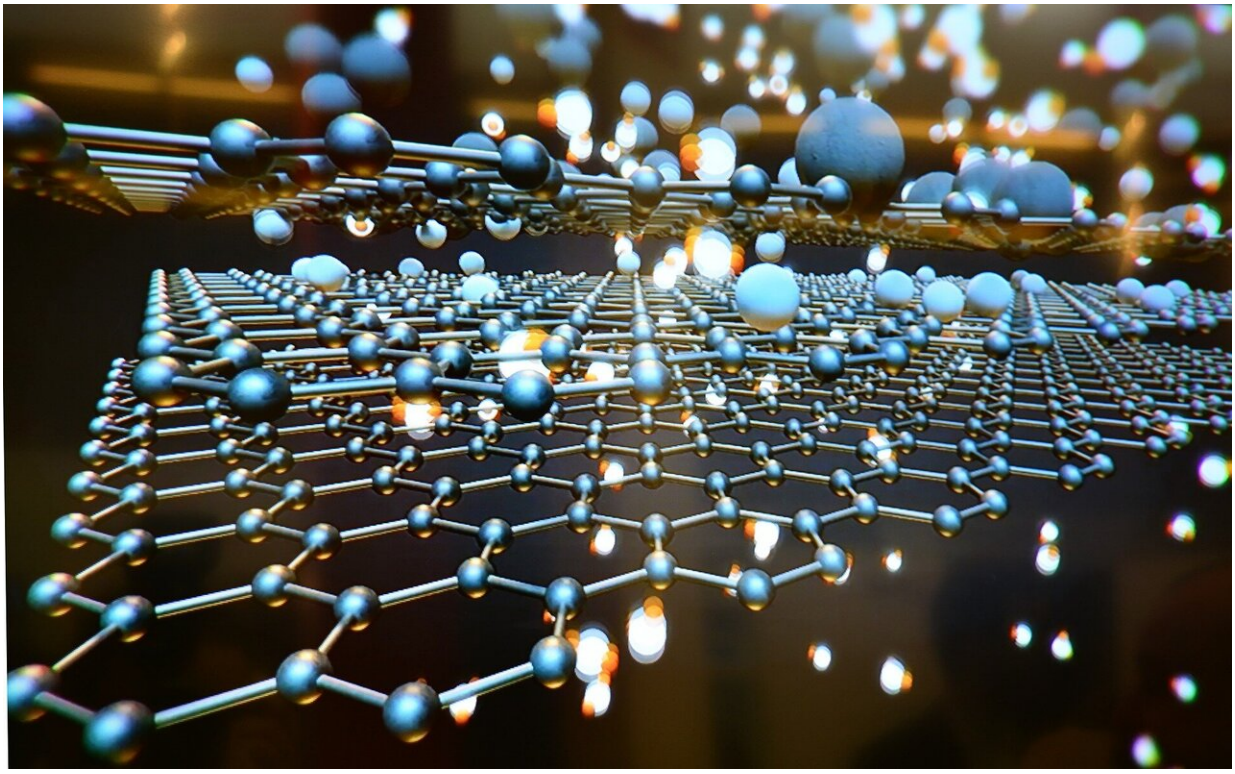

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Soldiers, athletes, and motorists could lead safer lives thanks to a new process that could lead to more efficient and re-useable protection from shock and impact, explosion, and vibration, according to a new study.

Pressurized insertion of aqueous solutions into water-repellent nanoporous materials, such as zeolites and metal-organic frameworks, could help to create high-performance energy absorbing systems.

An international research team experimented with hydrothermally stable zeolitic imidazolate frameworks (ZIFs) with a 'hydrophobic' cage-like molecular structure—finding that such systems are remarkably effective energy absorbers at realistic, high-rate loading conditions, and this phenomenon is associated with the water clustering and mobility in nanocages.

Researchers from the Universities of Birmingham and Oxford, together with Ghent University, Belgium, published their findings today in *Nature Materials*.

Dr. Yueting Sun, Lecturer in Engineering at the University of Birmingham, commented: "Rubber is widely used for shock absorption nowadays, but the process we have discovered creates a material that can absorb more mechanical energy per gram with very good reusability due to its unique nanoscale mechanism.

"The material has great significance for vehicle crash safety for both occupants and pedestrians, military armored vehicles and infrastructures as well as human body protection.

"Soldiers and police could benefit from better body armor and bomb suits, athletes might wear more effective helmets, knee pads and shoe insoles as the material is liquid-like and flexible to wear."

The reusability of the material, stemming from the spontaneous liquid extrusion, also enables the material to be suitable for damping purposes, meaning that it could be used to create vehicles with lower noise and vibration, as well as better ride comfort.

The material could also be incorporated into machinery to reduce harmful vibrations and noise—reducing maintenance costs. It could also be used to reduce the vulnerability to earthquakes of bridges and buildings.

Current state-of-the-art energy absorption materials rely on processes such as extensive plastic deformation, cell buckling, and viscoelastic dissipation—making it difficult to create materials that can provide efficient protection from multiple impacts.

More information: High-rate nanofluidic energy absorption in porous zeolitic frameworks, *Nature Materials* (2021). DOI: 10.1038/s41563-021-00977-6

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