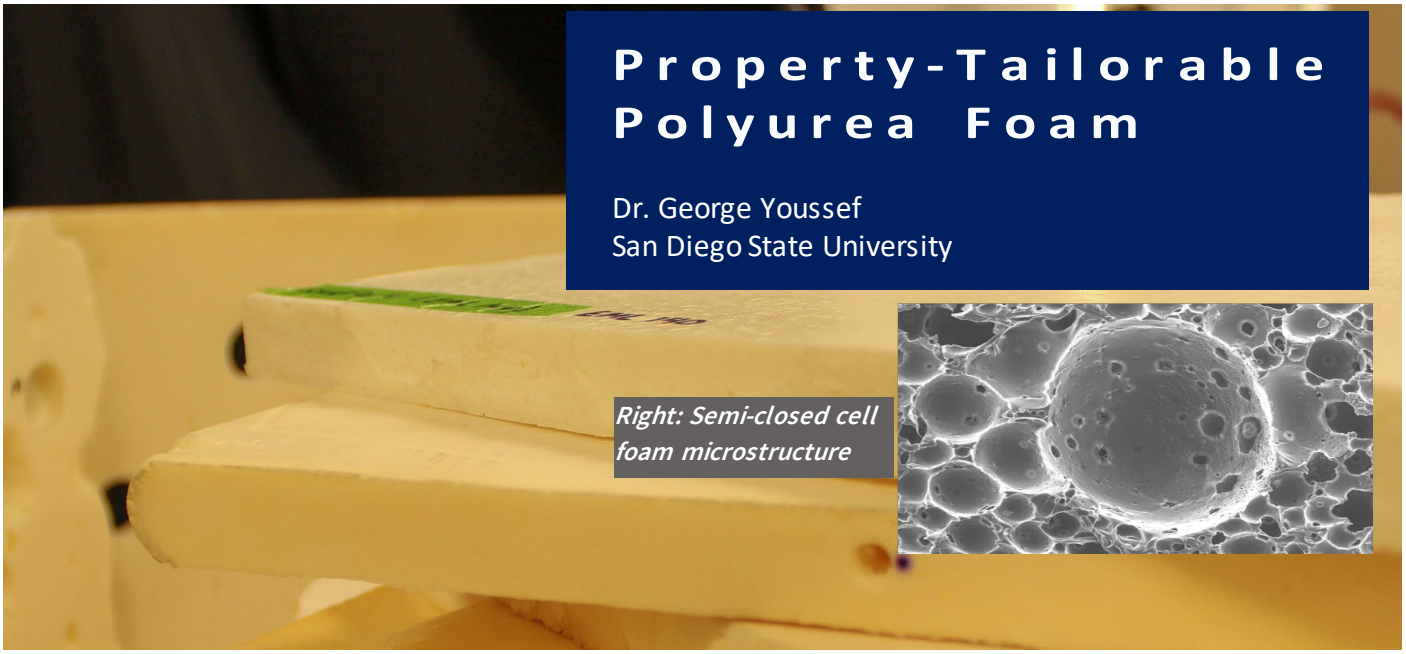

Property-Tailorable Polyurea Foam

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Right: Semi-closed cell foam microstructure

A versatile polyurea foam generated using a scalable manufacturing process provides more effective impact mitigation compared to heavier foams on the market

Polyurea foams are useful for absorbing energy and lessening the severity of impact loads in nearly any application. Most polyurea foams are classifiable as either open-cell foams or closed-cell foams. Open-cell foams more effectively absorb high impacts, while closed-cell foams better distribute loads over a wider area.

The invented polyurea foam has a novel "semiclosed cell" microstructure that inherits the desirable mechanical and physical properties of both open- and closed-cell structures, mitigating impact as good as or better than denser foams. The polyurea foam is the result of an invented manufacturing process that is geometry-independent and allows for greater control of the resulting foam properties. This invention discloses two new innovations in manufacturing polyurea foam with high level of controlling the thickness and density that is scalable. The process eliminates the need for a vacuum oven. In addition to greatly reducing the required energy, the lack of a vacuum oven lessens the possibility of premature degradation and enables more control over foam shape, thickness, and density.

Developed in part with funding from the DOD, industry can use the increased control to tailor the foam for any application.

In experiments, a prototype foam decelerated impacts more effectively than heavier competitors—one sample stored nearly double the energy (71.7 kJ/m^3) of a commercially available foam despite being 12% lighter. The inventors continue to optimize the foam, nearing densities of 90 kg/m^3.

ADVANTAGES

- Lightweight
- Net shape manufacturing
- Tailorable properties
- Energy efficient process
- Cost-savings at production scale

APPLICATIONS

- Military body armor (DOD-funded)
- Helmets
- Footwear - outsoles for walking/running shoes
- Aircrafts
- Automotive exteriors

PUBLICATIONS

- United States Patent No. 10,899,903 – "Scalable manufacturing method of property-tailorable polyurea foam"
- Research Publications List

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