

LATERAL THINKING IN MATERIALS: FROM FOOTBALL TO STEM CELL TECHNOLOGY

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ABSTRACT

Poisson's ratio is one of the most fundamental yet under-explored material properties. Overwhelming majority of materials have positive Poisson's ratios with values in a narrow range. In this talk I will discuss our effort in the development of materials with negative Poisson's ratios, or auxetic materials (auxetics). These materials expand when stretched and shrink when compressed, contrary to almost all naturally occurring or synthetic materials. Comparing to conventional materials auxetics exhibit many desired properties, i.e., enhanced toughness, improved impact and indentation resistance, bending stiffness and shear resistance, superior shape conformity, optimal dynamics, acoustic and dielectric properties etc. After a brief introduction, detailed discussion of our work on auxetic polyurethane (PU) foams will be presented. I will illustrate how a unified understanding of fundamental polymeric materials science and engineering, and thermodynamic principles lead to the establishment of comprehensive structure – morphology – processing - property relationship, and the successful development of ultra-fast, low-cost, robust and scalable manufacturing processes of auxetic foams. I will also discuss multifunctional auxetic foams with enhance sensing capability by synergy between auxetic structure and nanomaterials. A series of applications of auxetic foams will be discussed, including their use in prosthetics, protective sports equipment, wearable sensing and stem cell tissue engineering.

BIOGRAPHICAL SKETCH

Dr. Changchun Zeng is currently Professor in the Department of Industrial & Manufacturing Engineering of FAMU-FSU College of Engineering, and High-Performance Materials Institute at Florida State University (FSU). Dr. Zeng's research is in the areas of innovative materials and advanced manufacturing technology, particularly in multifunctional porous polymeric materials, polymer composites and nanocomposites, and polymer foams, their novel manufacturing process and applications. Dr. Zeng's research has attracted broad support from NSF, NASA, DoD and Department of Veterans Affairs etc., as well as industries. Dr. Zeng received his PhD in Chemical Engineering from The Ohio State University, MS in Chemical Engineering) and BS in Polymer Engineering, both from Zhejiang University. He joined Florida State University in 2007, after spending two years as Senior Research Engineer at Hexcel Corporation, a leading aerospace composites and carbon fiber manufacturer.