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A soft future: From sensor skin and robots to energy harvesters

SIEGFRIED BAUER

Professor
Soft Matter Physics Department,
Johannes Kepler University,
Linz,, Austria

ABSTRACT:

Scientists are exploring elastic and soft forms of electronic skin, soft robots and energy harvesters, dreaming to mimic nature and to enable novel applications in wide ranging fields, from consumer and mobile appliances to biomedical systems, sports and healthcare. Antagonistic materials with a wide range of mechanical, physical and chemical properties are employed, from liquids and gels to organic and inorganic solids. Combining such a diversity of materials into unctionalities never seen before, is an ideal playground for research in mechanics. In the presentation I will first introduce latest research examples in sensor skin development and discuss ultra-flexible electronic circuits, light emitting diodes and solar cells as examples. Additional functionalities of sensor skin, such as visual sensors inspired by animal eyes, camouflage, self-cleaning and healing and on-skin energy storage and generation are briefly reviewed. I will then proceed to discuss soft robots which allow actuation with distributed degrees of freedom. We show that different actuation mechanisms lead to similar actuators, capable of complex and smooth movements in 3d space. Drawing inspiration from well known mechanical instabilities, such as snap-buckling and snap-through transitions can be harnessed to achieve high speed, large stroke soft actuators. Finally, I will discuss a paradigm change in energy harvesting, away from hard energy generators to soft ones based on dielectric elastomers. Such systems are shown to work with high energy of conversion, making them potentially interesting for harvesting mechanical energy from human gait, winds and ocean waves. All of the examples chosen demonstrate the importance of research that highlights the role of mechanics in multi-disciplinary areas across materials science, physics, chemistry, biology, medicine and engineering.

BIOGRAPHY:

Siegfried Bauer joined the Johannes Kepler University in Linz, Austria in 1997, where he became a full professor and head of the Soft Matter Physics Department in 2002. He is a member of the editorial board of Advanced Science, Advanced Materials Technologies, Applied Physics Reviews, Applied Physics A and the IEEE Transactions on Dielectrics and Electrical Engineering. He received several awards for his work, including the Karl Scheel award of the Physical Society of Berlin in 1997, a pioneer of smart production award from the Austrian Society for Environment and Technology in 2010, and an ERC Advanced Investigators Grant in 2011. In 2016 he has been elevated to IEEE Fellow. His research centers on soft materials for sensors, transducers, flexible and stretchable electronics. He has coauthored more than 160 refereed scientific publications, including contributions to Science and journals of the Nature family.