Soft Electronic and Robotic Systems from Resilient yet Biocompatible and Degradable Materials

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Abstract

Nature inspired a broad spectrum of bio-mimetic systems – from soft actuators to perceptive electronic skins – capable of sensing and adapting to their complex erratic environments. Yet, they are missing a feature of nature's designs: biodegradability. Soft electronic and robotic devices that degrade at the end of their life cycle reduce electronic waste and are paramount for a sustainable future. At the same time, medical and bioelectronics technologies have to address hygiene requirements.

We introduce materials and methods including tough yet biodegradable biogels for soft systems that facilitate a broad range of applications, from transient wearable electronics to metabolizable soft robots. These embodiments are reversibly stretchable, are able to heal and are resistant to dehydration. Our forms of soft electronics and robots – built from resilient biogels with tunable mechanical properties – are designed for prolonged operation in ambient conditions without fatigue, but fully degrade after use through biological triggers. Electronic skins merged with imperceptible foil technologies provide sensory feedback such as pressure, strain, temperature and humidity sensing in combination with untethered data processing and communication through a recyclable on-board computation unit. Such advances in the synthesis of biodegradable, mechanically tough and stable iono-and hydrogels may bring bionic soft systems a step closer to nature.