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Hard/Soft composited materials for stretchable electronics

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HARD/SOFT COMPOSITED MATERIALS FOR STRETCHABLE ELECTRONICS

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Convergence between scientific disciplines creates myriads of new opportunities to the problems that traditional approaches have not provided the answers. For example, researches on materials engineering and nanofabrication can shed a light to the current challenges in clinical biomedical science. Specifically, this presentation describes how materials science is employed to solve fundamental and practical problems in the intimate integration of the state-of-art inorganic devices onto living organs or skins for biomedical research. [1]

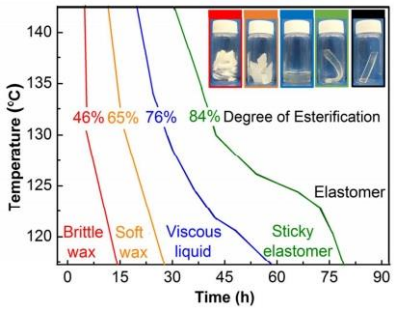

Figure 1 – Map that describes physical status and DE of PGS Bioresorbable Elastomer with respect to time and temperature of curing [2].

Firstly, bioresorbable elastomers make a basic building block for tissue scaffolds for soft, moving organs (such as heart, blood vessels, and smooth muscles) and for substrate material for resorbable devices for implantation. Poly(glycerol sebacate) (PGS) and its *nanocomposite* derivatives make up an attractive class of biomaterial owing to their tunable mechanical properties with programmable biodegradability. In practice, however, the application of PGS is often hampered by frequent inconsistency in reproducing process conditions. The inconsistency stems from the volatile nature of glycerol during the esterification process. In this presentation, we suggest that the degree of esterification (DE) can be used to predict precisely the physical status, the mechanical properties, and the degradation of the PGS materials [2]. To provide a processing guideline for researchers, we also provide a physical status map as a function of curing temperature and time (**Fig 1**). In addition, we demonstrate that the addition of molecularly rigid crosslinking agents and network-structured inorganic nanoparticles are also effective in enhancing the mechanical properties of the PGS-derived materials.

Secondly, operation of wearable or implantable bioelectronics requires a power source; piezoelectricity generating device allows the direct harvest of power source from natural movement. We have recently addressed an inexpensive pathway to convert commodity polyurethane foams into piezoelectricity nanogenerators by uniform growth of ZnO nanorods in the pores of the foams, followed by conductive material deposition and encapsulation processes [3]. The hard/soft integrated *nanocomposite* material has a potential to become an important building block for wearable bioelectronics system.

Thirdly, we demonstrate that a skin-adhesive electronic device from hard/soft material integration has a potential to aid patient populations in clinical setup [4] . Here, an emerging technology, called “epidermal electronics”, is introduced, where ultra-thin geometry allows for intimate and comfortable contact to patients’ chin, just like a temporary tattoo (**Fig 2**). The two objectives of this study were to assess the potential of epidermal electronics technology for swallowing therapy. This study showed comparative signals between the new epidermal sEMG patch and the conventional adhesive patches used by clinicians for swallowing therapy.

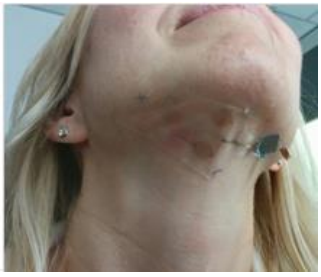

Figure 2 – Epidermal sEMG patch [4]

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