Stretchable Conductive Nanocomposite for Wearable and Implantable Electronics

Dae-Hyeong Kim[a,b]

[a]Center for Nanoparticle Research, Institute for Basic Science
[b]School of Chemical and Biological Engineering
Seoul National University, Seoul 08826, Korea
Email: dkim98@snu.ac.kr

Abstract

Intrinsically stretchable conductors form a vital component of advanced soft bioelectronics. And novel nanocomposites based on conductive nanomaterials have been used in diverse applications of implantable and wearable bioelectronics. Among many nanomaterials for the composites, silver nanowires (Ag NWs) have been popular. However, achieving highly conductive and soft composites simultaneously is challenging. Furthermore, because bioelectronics is necessarily exposed to biofluids, preventing Ag NW oxidation and Ag ion leaching is a significant challenge. Here we have achieved a highly conductive, biocompatible, and soft nanocomposite by using silver-gold (Ag-Au) core-sheath NWs and polystyrene-butadiene-styrene (SBS) elastomer. We synthesized ultralong Ag NWs encapsulated with a smooth and uniform Au sheath and then mixed them with the polymer. Phase separation of Ag-Au NWs and SBS occurs, which forms microstructures in the composite, reduces Young's modulus, and increase softness and conductivity of the composite. We used the nanocomposite to fabricate a customized multi-channel soft cardiac mesh for the diseased swine heart. The mesh could be also fabricated as a wearable device which monitored electrophysiological signals and applied electrical and thermal stimulations on the human skin.