Highly conductive, stretchable and biocompatible Ag-Au core-sheath nanowire composite for wearable and implantable bioelectronics

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Bioelectronics require materials that are highly conductive, stretchable, and biocompatible. However, these requirements are difficult to achieve because there is always a trade-off between improving conductivity and stretchability. In this study, we developed the novel Ag-Au nanocomposites composed of ultralong gold-coated silver nanowires in an elastomeric matrix. The high aspect ratio of the ultralong Ag-Au nanowires and their well-interconnected percolation network realized a high conductivity of 41,850 S/cm (max: 72,600 S/cm). Phase separation of nanocomposite solution during the solvent drying process generates a microstructure that confers an optimized stretchability of 266% (max: 840%). The gold sheath deposited evenly on the surface of the silver nanowire prevents oxidation and silver ion leaching, making the composite biocompatible and maintaining its high conductivity. Using the nanocomposite, we successfully fabricated wearable and implantable soft bioelectronics that could be conformally integrated with human skin and swine heart for continuous electrophysiological recording, and electrical and thermal stimulations.