Highly conductive and elastic nanomembrane for skin electronics

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Intrinsically stretchable electronics are opening new opportunities in various human-integrated applications such as health monitoring, health diagnosis, and human-machine interface. A key component of intrinsically stretchable electronics is an intrinsically stretchable conductor which transmits electrical signals in the stretchable system. For reliable operation of the electronics, an ultrathin stretchable conductor which simultaneously fulfills metallike conductivity and high stretchability. Despite previous researches, obtaining such a stretchable conductor has been challenging. Here, we present a float assembly method to manufacture a nanomembrane that satisfies all these properties. The exceptional properties result from its unique structure in which a monolayer of closely-assembled silver nanowires is partially-implanted in an elastomeric membrane with nano-thickness (< 250 nm). The partially-exposed silver nanowires enable cold welding and stacking process for improving electrical performances, which results in conductivity over 100,000 S/cm and high stretchability over 1,000%. The structure also allows high-resolution patterning using photolithography. Photo-patterned nanomembranes can be applied to various devices ranging from simple skin-attached electrode to multilayer sensor array.