

Development of conductive hydrogels for flexible bioelectronics

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Hydrogel bioelectronics is a rapidly developing field that bridges the gap between hard electronic devices, which rely on electronic charge carriers, and soft biological tissues, which primarily conduct ionic signals. In this work, we explored various hydrogels to engineer conductive hydrogel materials suitable for applications in biosensing and bioelectronics. Our main focus was on developing photocurable conductive hydrogels that can be seamlessly adapted to additive manufacturing technologies. Notably, we observed that conductive hydrogel membranes coating laser-induced graphene (LIG) electrodes significantly enhanced electrochemical signals in the presence of redox probes, as illustrated in Fig. 1a. Moreover, electrical measurements confirmed high electrical conductivity with minimal variation across a broad frequency range, as depicted in Fig. 1b. Importantly, 3D printing of the developed conductive hydrogel into microneedle structures demonstrated excellent printability and high resolution using a DLP printer. The obtained results demonstrated that these conductive hydrogels hold great promise as sensing platforms.

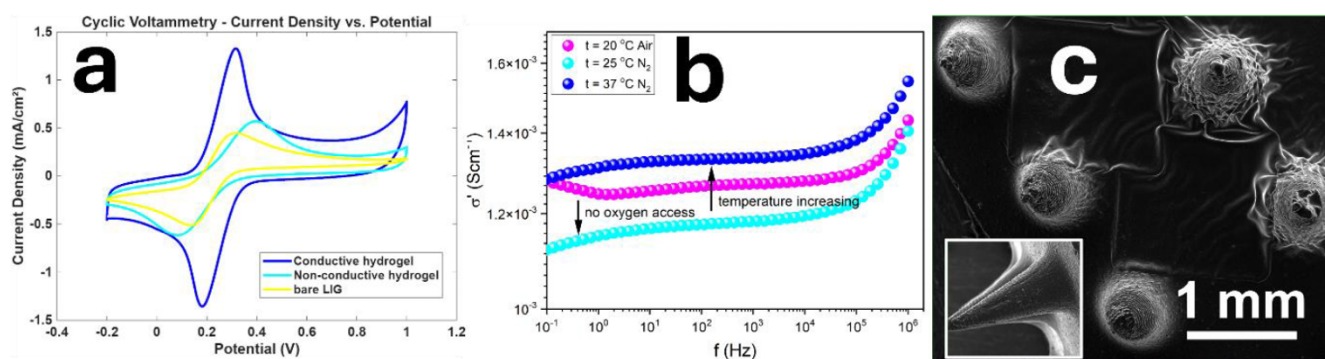


Figure 1. (a) Cyclic voltammograms (CVs) recorded for bare LIG and hydrogel-coated LIG samples in 5 mM $[\text{Fe}(\text{CN})_6]^{3-/4-}$ solution at a scan rate of 50 mV/s. (b) electrical conductivity of the hydrogel vs. frequency at three different temperature; (c) SEM images of the 3D printed conductive hydrogel microneedles captured from the top view and side view. Keywords: Conductive hydrogels, 3D printing, hydrogel bioelectronics, laser-induced graphene, biosensor.