High Resolution Pattening of Liquid Metal on Hydrogel for Flexible, Strectchable and Self-Healing Electronics

Chengtao Xu, Biao Ma, Hong Liu†

State Key Labratory of Biological Electronics, Southeast University, Nanjing, 210096, China.
(Emails: 220184950@seu.edu.com for Chengtao Xu; neumabiao@163.com for Biao Ma; liuh@seu.edu.cn for Hong Liu)

Abstract

Soft, wet and biocompatible hydrogels have emerged as a promising material candidate for flexible and stretchable electronics[1]. However, most existing conductors designed for hydrogel suffer from poor biocompatibility, low conductivity, or mechanical mismatch with hydrogel. In this work, we show direct patterning of intrinsically stretchable and highly conductive liquid metal (LM) on hydrogel substrate for completely soft and stretchable hydrogel electronics without mechanical mismatch[2]. This was achieved by patterning of liquid metal dispersed with magnetic microparticles on the wet hydrogel using magnetic field. High resolution and uniform LM patterns were obtained with an assistance of a laser cutting mask. In addition, the encapsulated liquid metal in the hydrogel matrix can also enhance the mechanical strength of the hydrogel. Moreover, mechanical and electrical self-healing can be achieved simultaneously at the damaged region, by taking advantages of the hydrogen bonds in the PVA hydrogel network and the merging of the liquid metal, respectively. We also demonstrated a few applications of the LM enabled hydrogel bioelectronics for wearable sensors, soft wireless communication device and self-healing electronics.

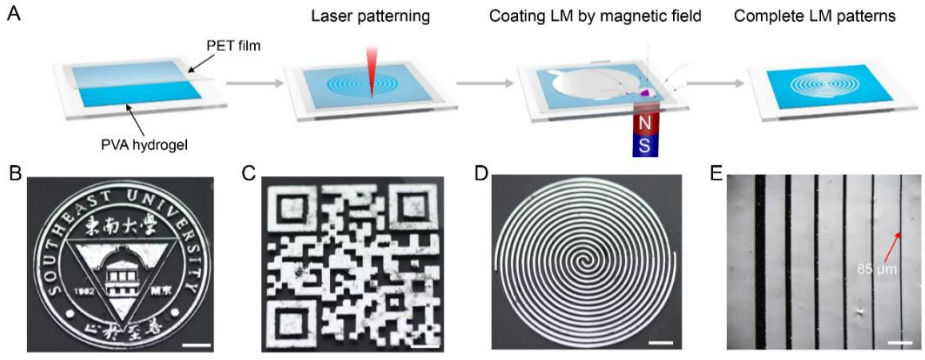

Figure 1. A) Schematic illustration of fabrication process of the LM-based hydrogel electronic devices. B-D) Optical images of LM patterns on PVA hydrogel including a logo of Southeast University, (C) a QR code and two entangled spirals. Scale bar: 5 mm. E) Optical microscopic image of single line LM pattern on PVA hydrogel (scale bar: 1 mm)

References

[1] Hyunwoo, Y.; Baoyang, L.; Xuanhe, Z.: Hydrogel bioelectronics, Chem. Soc. Rev., Vol 48, pp. 1642-1667, 2019

[2] Ma, B., Xu, C., Chi, J., Chen, J., Zhao, C., Liu, H.: A Versatile Approach for Direct Patterning of Liquid Metal Using Magnetic Field. Adv. Funct. Mater. 2019, 1901370. https://doi.org/10.1002/adfm.201901370