3D printing-based pressure sensor with porous dielectric elastomer for healthcare monitoring

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Wearable and flexible capacitive pressure sensors have attracted a consideable of interest and increasing demands over the last decades due to their importance in relation to various advanced applications such as electronic skin, textiles, soft ronotics, and mobile healthcare aids [1-2]. In this work, we demonstrate the facile and cost-effective approach to fabricate flexible capacitive pressure sensor (Fig. 1a). The fabricated pressure sensor consisted of two polyimide (PI) films patterned with five metal lines and the porous-structured elastomer (polydimethylsiloxane, PDMS) between them (Fig. 1b). The porosity in PDMS can be accurately controlled by adjusting the densities of the 3D-printed, water-soluble polyvinyl alcohol (PVA) templates; hence, the sensitivity of the sensor can be tuned according to the specific purpose. The pressure sensor performance was evaluated by measuring the the relative change in capacitance ($(C–C_0)/C_0 = \Delta C/C_0$, where C_0 is the initial capacitance) with various pressure levels (0 ~ 30 kPa) using custom-designed equipment, obtaining the sensitivity (S) of 0.21 kPa^{-1} (Figs. 1c and 1d). Finally, we applied our sensors to measure the respiration signals for healthcare monitoring (Fig. 1e).

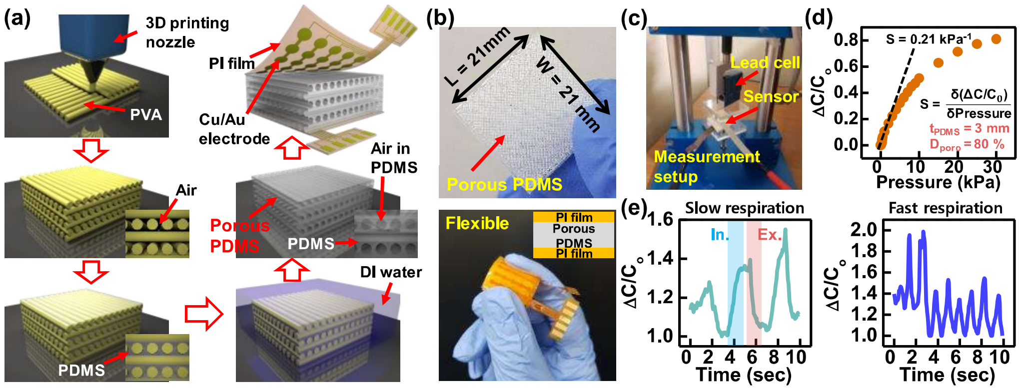

Fig 1. (a) Fabrication processing steps of the pressure sensor with the porous PDMS layer. (b) Photographs of porous PDMS after dissolution of the 3D-printed PVA template (top) and overall sensor structure (bottom). (c) Custom-designed equipment for evaluating the fabricated pressure sensor. (d) Relative change in capacitance of the pressure sensor with 80% porosity. (e) Measured slow (left) and fast respiration (right) signals using the fabricated sensor.

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References [1] S.C.B. Mannsfeld, et al. *Nat. Mater.*, 9(859), (2010). [2] S. Kang, et al. *Adv. Electron. Mater.*, 2(12), (2016).