Sandwich fixation of electronic elements using free-standing elastomeric nanosheets for low-temperature device processes

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Supporting figures



Figure S1 (a) Preparation of SBS nanosheets and functionalization with cationic acrylic copolymer using a roll-to-roll technique. **(b)** Fabrication of a free-standing SBS nanosheet with inkjet-patterned electronic circuits.



Figure S2 The free-standing SBS nanosheet was manipulable by tweezers in water (a). The SBS nanosheet could be stretched ($1 \approx 90 \text{ mm}$) to more than 300% of its original size ($l_0 \approx 30 \text{ mm}$). The obtained SBS nanosheet supported by a paper-tape frame (b) was manipulable in atmosphere. Scale bar: 10 mm.



Figure S3 Microscopic images of silver nanoparticles patterns (line width: 1.5 mm and dumbbell diameter: 4 mm) inkjet-printed on pristine (a), acrylic-copolymer-coated (b), plasma-treated (c) and chitosan-coated (d) SBS nanosheets.



Figure S4 Surface and back side of the silver lines inkjet-printed on SBS nanosheets annealed at 110 °C (a) and at 180 °C (b).



Figure S5 (a) A chip LED was sandwiched between a PS nanosheet with silver lines and another PS nanosheet as a cross-sectional diagram. Back side of the connection part between silver lines printed on a PS nanosheet and the electrodes of the chip LED. (b) Chip LEDs on a glass plate covered with an SBS nanosheet (thickness: ca. 620 nm) and a PS nanosheet (thickness: ca. 590 nm). After turning the glass plate upside down and tapping on the back side, the SBS nanosheet showed sufficient durability to fix the chip LED. The PS nanosheet was broken, causing the chip LED to fall. Scale bar: 1 mm.



Figure S6 (a) Design of electrodes inkjet-printed on SBS nanosheets for contact resistance measurement between printed silver lines and chip resistor electrodes. (**b**-e) Cross-sectional schemas for the setup of contact resistance measurement. (**b**) The SBS nanosheet with printed electrodes was attached on a PDMS board and the chip resistor was mounted over the electrodes. (**c**) The chip resistor was covered with SBS nanosheets (250 nm, 620 nm, and 2500 nm). (**d**) The chip resistor was fixed on a free-standing SBS nanosheet. The SBS nanosheet with electrodes was attached on a PDMS board with a hole (ϕ : 5 mm) and the chip resistor was fixed over the hole. (**e**) The chip resistor was fixed between two SBS nanosheets, which was then transferred to a skin model.

Supporting movie

Movie S1 The LED lighting circuit-laden SBS nanosheet attached to a skin surface. Operation of the chip LED was durable against tilting, overturning, and motion of the wearer.