

Supplementary Materials

Stretchable Shape-sensing Sheets

Movie S1 - Estimation of 3D Space Curves

Movie S2 - Estimating Surface Contours on Pneumatic Bladders

Text S1 - Stretching an S3 Sheet

Text S2 - Energy Dispersive X-Ray Spectroscopy of MPR121 Packages

S1 Stretching an S3 Sheet

As mentioned in the main text, we stretched the circuits to 30% strain, as shown in **Figure S1**. Note that the circuit elongated along the y direction, while narrowing in the x direction, due to the positive Poisson ratio of the rubbery VHB substrate.

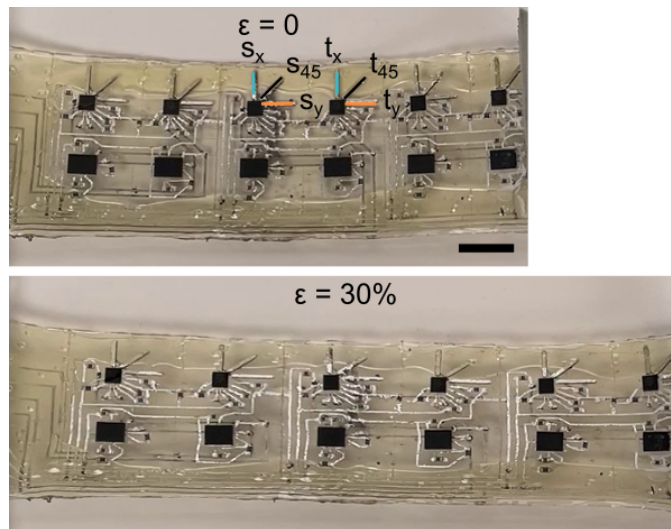


Figure S1: **Manufacturing an S3 sheet.** Photos of a skin in its unstretched (top) and stretched (bottom) state, with sensors labelled to correspond to the data plotted in Figure 5. The scale bar in the top image denotes 1 cm, and applies to both images.

S2 EDS of MPR121 Packages

To determine the presence of alloying on the surface of the MPR121 after contact with bGaIn, we ran energy dispersive x-ray spectroscopy (EDS) on the leads of a quad flat no-lead (QFN) package after removing it from an S3 sheet (**Figure S2**). A fresh MPR121 IC had a surface of primarily nickel and

palladium, with the housing being silicon and oxygen (**Figure S2a**). The electrodes on a used MPR121 showed substantial residual gallium and indium (**Figure S2b**), matching our visual observation of biphasic gallium-indium (bGaIn) seen on the surface. The Ga and In images do not show complete correlation, suggesting some elemental separation within the bGaIn. Finally, the surface of a used MPR121 that was subsequently cleaned with a slightly basic cleaner (diluted Simple Green, Sunshine Makers Inc.) exhibited almost the same profile (**Figure S2c**) as an unused MPR121 (**Figure S2a**). This suggests only negligible alloying occurred, and any residual compounds that formed during contact with bGaIn could be easily removed.

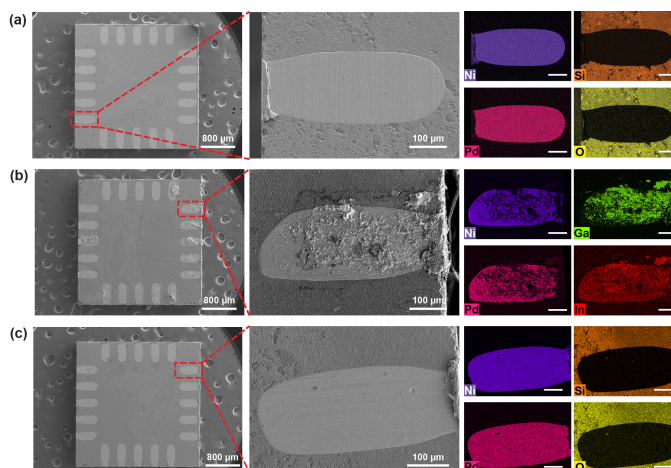


Figure S2: Energy-Dispersive Spectroscopy (EDS) of an MPR121 integrated circuit (IC). a) A new, untreated MPR121 IC. The dominant elements visible on the surface of the exposed electrodes are nickel and palladium, with the housing of the IC being primarily Silicon and Oxygen. b) An MPR121 that was removed from an S3 sheet. The MPR121 electrodes now have significant deposits of Gallium and Indium from the bGaIn that was used in the stretchable circuits. c) An MPR121 that was removed from an S3 sheet and then cleaned with Simple Green cleaning solution. The electrode surfaces are again almost entirely showing nickel and palladium. For (a-c), the left side shows the entire MPR121 circuit, while the middle image shows a zoomed-in perspective of one electrode. The false-color images on the right show the dominant elements found in the region shown in the middle column. Note that each MPR121 in (a-c) were separate specimens, imaged during the same EDS measurement session, at standard atmospheric conditions.