**Screen printing of stretchable electrodes for large area LED matrix**

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**Supplementary Figure 1.** Thickness of the screen printed electrodes and LED solder pads before pre-strain in substrate was released is ~ 18.6 µm. Measurement was made using a profilometer.

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**Supplementary Figure 2.** Effect of curing temperature on stretchability of the screen printed Ag electrodes. a) Scanning electron microscope (SEM) images of the screen printed Ag electrodes after curing. From left to right: Ag was cured at 130 °C, 150 °C and 170 °C respectively. The scale bars are 1 µm. b) Table comparing the resistivity of the Ag electrodes cured at different temperatures. The resistivity of the electrodes (screen printed Ag particles after curing) is approximately an order of magnitude higher than bulk Ag. c) SEM images of the broken Ag line when strained excessively. The scale bars are 1 µm. d) Table comparing the stretchability of the Ag electrodes cured at different temperatures. The normalized strain at failure is the strain at failure of the electrode as a ratio of the strain at failure of an electrode cured at 170 °C.

**Effect of curing temperature**

The resistances of the Ag pastes cured at different temperatures for 30 minutes are compared. Resistance of the sample cured at 170 °C is ~ 78 % that of the sample cured at 150 °C. This is attributed to the better connectivity of Ag particles after curing at a higher temperature (as evident from the SEM images shown in Supplementary Figure 2a. The electrical resistivity of the samples (ρ) are calculated based on the measured resistance (*R*), length (*L*), width (*w*) and thickness (*t*) of the samples via the following relationship:



The electrical resistivity of the samples cured at 150 °C and 170 °C are 96 e-8 Ω-m and 75 e-8 Ω-m respectively. These values are about 1 to 2 orders of magnitude higher than the resistivity of bulk silver ( 1.59 e-8 Ω-m). As the sample cured at a higher temperature forms a more continuous network, it is stiffer and exhibits lower stretchability.

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**Supplementary Table 1.** Moduli of the different components in the stretchable electrodes.

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**Supplementary Figure 3.** a) Current-voltage curve of a single LED measured at its electrodes (blue diamond symbol). Current-voltage curve of two parallel LEDs measured at the LED solder pads of one of the LEDs (red square symbol). Current-voltage curve of two parallel LEDs and electrodes (in series) in the LED matrix measured at two neighboring contact pads (green triangle symbol). The contact pads and LED solder pads are identified in the right image. b) Resistance-voltage curve of a single LED measured at its electrodes (blue diamond symbol). Resistance-voltage curve of two parallel LEDs measured at the LED solder pads of one of the LEDs (red square symbol). Resistance-voltage curve of two parallel LEDs and electrodes (in series) in the LED matrix measured at two neighboring contact pads (green triangle symbol).

**Resistance of the individual components in the 2 by 2 LED matrix at 2 V.**

The resistance of a single LED measured at its electrodes is 170 Ω.

The resistance of two parallel LEDs measured at the LED solder pads of one of the LEDs is 100 Ω.

The resistance of two parallel LEDs and electrodes (in series) in the LED matrix measured at two neighboring contact pads is 124 Ω.

The resistance of the electrodes (in series) is ~ 124 – 100 = 24 Ω.

The resistance of a single LED, the electrodes and solder interface (in series) is ~ 2 X 100 = 200 Ω.

The resistance of the electrodes and solder interface (in series) is ~ 200 – 170 = 30 Ω.

As the resistance of the electrodes and solder interface (in series) is significantly lower than the resistance of the LED, most of the potential drop occurs across the LED:  
Potential drop across LED is ~ 2 X 170 / 200 = 1.7 V.

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**Supplementary Figure 4.** Stretchability of the LED matrix in the axis perpendicular to which the LED pads lie along. Optical images of two different LED matrices with similar layout at various levels of strain. The strain ranges from 0 % (top left image) to 25 % (bottom left image) for sample A and from 25 % (top right image) to 40 % (bottom right image) for sample B. A LED in sample A fails at 25 % as the electrode leading to it is fractured (circled in red).