Large Area Solution Processed Transparent Conducting Electrode based on Highly Interconnected Cu wire Network

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Electronic Supplementary Information (ESI)

Figure S1. Photograph of crackle template formed from CP-1 on a A4-size PET substrate (centre). Optical micrographs taken from different positions of the template show crackles formed uniformly with high level of interconnection all over the substrate. Scale bar 1 mm.
**Figure S2.** SEM images of crackle dispersions showing (a) colloidal SiO$_2$ in CP-1 and (b) acrylic resin in CP-2.

**Figure S3.** Optical microscopy of crackle network obtained for different concentrations of CP-1 dispersion. (a) 0.15 g/mL (b) 0.3 g/mL (c) 0.6 g/mL and (d) 0.9 g/mL. The estimated mean crackle widths are 20, 40, 70 and 120 µm, respectively. In each case, 700 µL dispersion was used for 5 cm$^2$ area. Scale bar: 200 µm.

The crack width is seen to increase with the concentration due to increased thickness of the dried layer. The mean crackle width was calculated by averaging over 10 different locations.
**Figure S4.** X-ray diffraction pattern of a Cu network formed from CP-1.

**Figure S5** Large area Cu wire network/PET transparent conducting electrode prepared from CP-1 crackle precursor, by dipping the Au seed layer in Cu electroless bath solution. Underneath is a computer screen display and the text is clearly visible. The measured transmittance is ~75% and sheet resistance, $4.5 \, \Omega/\square$. 
Figure S6. (a) Optical microscopic images of Pd seed layer formed over CP-2 crackle. (b) Pd L EDS map after Cu electroless deposition over Pd seed layer. Only a weak Pd signal may be seen.

Figure S7. Transmittance spectra and resistance values of Cu network TCEs prepared from different crackle width templates.

Figure S8. Excessive dipping in Cu bath solution can lead to non-specific deposition as shown in the image.
Figure S9. (a) Schematic showing the fabrication of TCE by physical deposition of metal over a crackle template. (b) Optical profiler image of Cu TCE fabricated from CP-2. (c) Transmittance of the Cu wire network. Photograph of the sample is shown in the inset.

Note S1

An estimation of the cost of Pd and Au seed layers used for Cu network based TCE fabrication is provided below. A sample size of 10 cm$^2$ is considered for the calculation.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Chemicals Used</th>
<th>Cost /Quantity</th>
<th>Quantity used (mg)</th>
<th>Estimated Cost/sample ($)</th>
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<tbody>
<tr>
<td>1</td>
<td>Pd (II) Chloride (Sigma Aldrich)</td>
<td>1g (51.3 $)</td>
<td>2.56</td>
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<tr>
<td>2</td>
<td>Au by sputtering</td>
<td>1 g (47.5 $)</td>
<td>1.93</td>
<td>0.09</td>
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