Flexible metallic interconnects for displays and large-area electronics

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Large-area flexible electronics applications, ranging from displays on nonplanar surfaces to conformable bioelectronic applications, require an interconnect technology that can withstand bending and possibly stretching without losing electrical integrity. We will present a robust metallization scheme based on a layer of ductile metal islands, that can be deposited on a variety of compliant substrates and can withstand very large mechanical strains without rupture.

Thus, metallization containing a ~50 nm thick granular indium interlayer combined with a stiff chromium adhesion layer, can be deposited on highly formable film substrates and strained up to 40% without loss of integrity and with an increase in resistance of less than a factor of two. The working mechanism is the bridging of cracks in the stiff adhesion layer by ductile indium. The same islanded metallic interconnects can withstand low-strain 2% fatigue loading for tens of thousands of cycles without a measurable change in resistance.[1]

In addition to flexible LCD-based displays, this type of interconnect may be promising for bioelectrical applications, including implantable electronics, given an acceptable encapsulation technique.

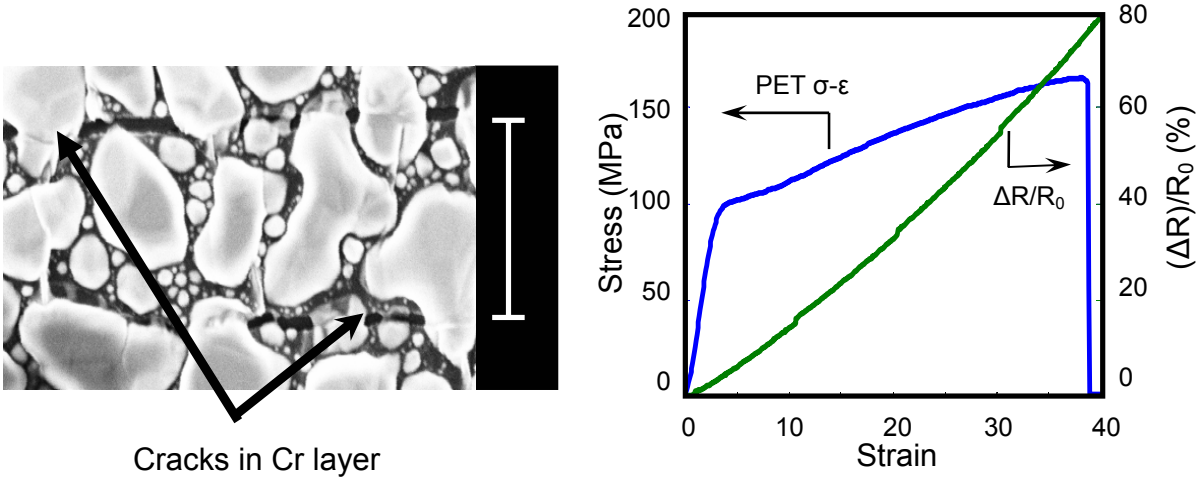

FIG. 1. SEM micrograph of Cr/In metallization showing the bridging of cracks in the stiff Cr adhesion layer by ductile In islands (left; marker corresponds to 1 μm); stress-strain curve showing relative change in resistance of Cr/In interconnect on a compliant polyethilene terephthalate (PET) substrate strained up to 40% (right).

1. D. P. Wang, Frederick Y. Biga, A. Zaslavsky, and Gregory P. Crawford, "Electrical resistance of island-containing thin metal interconnects on polymer substrates under high strain", *J. Appl. Phys.* **98**, 086107 (2005).