"Magic-ink" Paper from Photopatterned Conjugated Polymer Electrochromic Nanofibers

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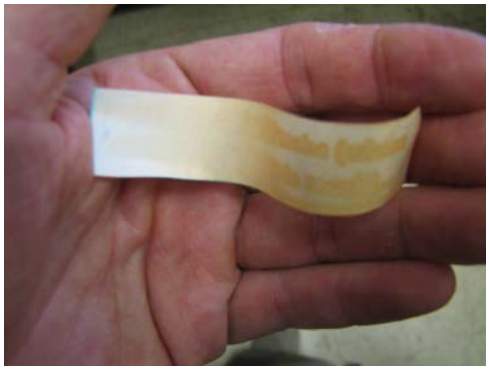
Increasing the processability of conducting polymers remains a focus of research in order that these materials may be introduced into mass production. Our group has developed a technique termed solid state oxidative crosslinking (SOC) [1], which makes it possible to handle a processable precursor copolymer instead of an insoluble conducting product. The precursor polymer contains pendant units which will become the conducting polymer structure upon SOC. Once the precursor copolymer is deposited, the conducting polymer can be obtained either chemically or electrochemically. The SOC technique has been successfully applied, together with dip-pen nanolithography or e-spinning, to obtain nanostructures composed of conducting polymers (nanofibers and nanolines) [2-3]. We report the inclusion of a photocrosslinkable unit in the precursor polymer structure so that it can be processed via any conventional photopatterning technique. As the technique does not have any limitations on the substrate used for these depositions, photopatterned electrochromic characters can be shown on conventional paper. These nanofibrous electrochromic polymers on paper, once converted by exposure to ultraviolet light, can be chemically switched between their oxidized and reduced states, thus causing a color change. The preparation of electrochromic paper is but one of many possible applications of this technique. Other potential used for a precursor approach towards the patterning of conducting polymers include the creation of microelectronic circuitry and electrochromic diffraction gratings. This simple, powerful, and versatile technique erases processability issues while encompassing a large swath of potential polymer and copolymer structures.



"Magic-ink" paper from photopatterned conducting polymer nanofibers showing invisible and colored characters,

[1] S Y Jang, G A Sotzing and M Marquez, *Macromolecules* 2002, **35**, 7293 "Intrinsically conducting polymer networks of poly(thiophene) via solid-state oxidative cross-linking of a poly(norbornylene) containing terthiophene moieties."
[2] S Y Jang, M Marquez and G A Sotzing *J. Am. Chem. Soc.* 2004, **126**, 9476 "Rapid direct nanowriting of conductive polymer via electrochemical oxidative nanolithography."
[3] S Y Jang, V Seshadri, M S Khil, A Kumar, M Marquez, P Mather and G A Sotzing, *Adv. Mater.* 2005, **17**, 2177 "Welded electrochromic conductive polymer nanofibers by electrostatic spinning."