An Investigation of Polyelectrochromism in Water-Dispersible Polyaniline for Use in Passive Display Elements

Jacob D. Tarver* and Yueh-Lin Loo
Department of Chemical Engineering, Princeton University

Poster (2:20 PM)

The promise of polyaniline (PANI)-based systems in applications such as electrochromic window coatings or billboards is motivated by the coupled nature of PANI's redox and chromic properties [1, 2]. In its fully reduced, intermediate, and oxidized states, PANI is electrically insulating and is characteristically transmissive in the yellow, blue, and violet visible regions, respectively. Upon protonation of the intermediate state, the polymer becomes electrically conductive and its transmission shifts to the green region [3]. This proton dependence has historically limited the electroactivity of small molecule acid-doped PANI to acidic media [4], but recent studies have shown polymer acid-doped PANI to be electrically active, even at elevated pHs [4]. We characterized the electrochromic behavior of water-dispersible poly(2-acrylamido-2-methyl-1-propanesulfonic acid)-doped PANI, or PANI-PAAMPSA [5-6], by spectroelectrochemistry to assess its stability and tunability across pH 3 – 9. Stable and reversible electrochromic transitions between green/clear, green/violet, and violet/clear states were observed for pH 3-7. More basic conditions elicited direct violet/clear transitions. Switching times for the three distinct electrochromic states were fastest at pH 5, but could be tuned by varying film thickness, PAAMPSA molecular weight, and post-deposition treatment. Incorporation of a polymer acid dopant, as opposed to small-molecule acids, thus affords enhanced robustness to PANI and opens the door for a range of passive display applications.

[1] D. C. Trevedi, in: H.S. Nalwa (Ed.), *Conductive Polymers: Synthesis and Electrical Properties, Handbook of Organic Conductive Molecules and Polymers, Vol. 2*; Wiley: New York (1997).
[2] T. Kobayashi, H. Yoneyama, and H. Tamura, *J. Electroanal. Chem.* 419, 161 (1984).
[3] A. J. Heeger, *Rev. Mod. Phys.* 681, 73 (2001).
[4] J. Tarver, J. E. Yoo, and Y.-L. Loo, *Chem. Mat.*, Manuscript submitted for publication (2008).
[5] J. E. Yoo, J. L. Cross, T. L. Bucholz, K. S. Lee, M. P. Espe, and Y.-L. Loo, *J. Mat. Chem.* 1268, 17 (2007).
[6] J. E. Yoo, T. L. Bucholz, S. Jung, and Y.-L. Loo, *J. Mat. Chem.* 3129, 18 (2008).