PENNSTATE

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
COLLEGE OF EARTH AND MINERAL SCIENCES

~~Special Polymer Physics Seminar ~~

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10:00 AM Monday, March 22th, 2010
301 Steidle Bldg.

Redox-Active Radical Polymers for Charge-Storage/Transport Materials: Organic Rechargeable Battery and Memory Applications

Emerging technologies with plastic-based electronic devices, such as organic light-emitting diodes, E-papers, and transistors, flexible power sources have also attracted intense interest. We focused on durable, but highly redox-active property of organic radicals, and developed a new class of redox polymers for electrode-active, charge-storage materials in a rechargeable battery.[1]

Radical polymers bearing a high density of unpaired electrons in a pendant, non-conjugated fashion on each repeating unit provided a rapid, reversible, and quantitative redox behavior in an electrode form. Careful selection of radicals (TEMPO, galvinoxyl, and nitronylnitroxide, etc.) produced remarkably stable p- and n-type redox couples, which lead to the totally organic-based rechargeable batteries. The power-rate performance of these cells was excellent (360 C rate, 10 sec charge/discharge), as a result of the simple, rapid redox process of the organic radical moieties with no associated structural change in the amorphous polymer layer. Organic polymer-based electrodes are amenable to roll-to-roll or inkjet processing, which allowed the fabrication of a flexible, paper-like, and transparent rechargeable energy-storage device, which could be embedded in radio-frequency identification tags, smart cards and electronic paper.

Recent work on radical-containing block copolymers for organic nonvolatile memory will be also described.[2,3]

Ref. 1). T. Suga, H. Nishide, et al., *Adv. Mater.*, **2009**, *21*, 1627-1630; 2) Y. Yonekuta, H. Nishide, et al., *J. Am. Chem. Soc.*, **2007**, *129*, 14128-14129; 3). T. Suga, H. Nishide, et al., *Chem. Lett.*, **2009**, *38*, 1160-1161.