# Charge Transport in Conjugated Polymers During Redox
## （導電性高分子の酸化還元過程における電荷輸送）

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Conjugated polymers switch between oxidized and reduced states in response to changes in electrochemical potential, which cause electrons to be donated/removed from the polymer backbone and, simultaneously, charge compensating ions to enter/exit the material. Understanding this charge transport is critical to improving the performance of devices based on electrochemical switching, such as electrochromic windows, drug delivery systems, and actuators.

We have begun physics-based modeling of this charge transport. I shall present results and modeling using an experimental configuration that allows one to measure ion transport directly and independently from electron transport in polypyrrole thin films. This device geometry makes the path for ions much longer than that for electrons, ensuring that ion transport is the rate-limiting step. The ion transport is visualized though the electrochromic color change of the film as the electrochemical reaction proceeds. During ion ingress, a phase front between the reduced and oxidized states is observed to travel into the film, the speed of which is proportional to the applied voltage. We have formulated a 1-D model with drift and diffusion terms, and this model captures much of the behavior.

**Elisabeth Smela** received her B.S. in physics from MIT in 1985 and completed her PhD in electrical engineering at the University of Pennsylvania in 1992. She then worked at Linköping University in Sweden and at Risø National Lab in Denmark developing microfabricated conjugated polymer devices. In 1999 she joined the start-up company Santa Fe Science and Technology in New Mexico as Vice President of Research and Development. She joined the faculty of the Department of Mechanical Engineering at the University of Maryland in September 2000, where she is now an Associate Professor. She was awarded the Presidential Early Career Award for Scientists and Engineers (PECASE) in 2004 for research in dielectric elastomer actuators for microrobotics. She also received the DuPont Young Professor Award in 2003, the engineering school's Kent Teaching Award for Junior Faculty in 2004, and the university's Outstanding Invention of 2004. Her research interests are in polymer MEMS and bioMEMS, and more generally in combining organic materials with conventional inorganic materials to make new micro-scale devices.

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