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Cation Effects on Electroactive Responses of Conjugated Polymers[1]

XUEZHENG WANG, ELISABETH SMELA, Dept. of Mech. Engr., UMCP — The ions present in the electrolyte in which a conjugated polymer actuator is cycled are known to affect performance such as response time and volume changes. Understanding how speed, force, strain, etc. are affected by ion size and other ion characteristics is critical to applications, but is not yet well understood. In this paper, we first present effects of monovalent and divalents cation mass on transport velocity and volume change in polypyrrole doped with dodecylbenzenesulfonate, PPy(DBS), which is a cation-transporting material. Volume change, measured by mechanical profilometry, was greatest for Li^+ and decreased in order of atomic mass: Na^+, K^+, Rb, and Cs^+. This was expected because prior studies had shown that the ions are hydrated when they enter the PPy, and Li^+ has the largest hydration shell. Ion transport, measured by phase front propagation experiments, was also fastest for Li^+, however, contradicting the expectation that larger species would move more slowly. Possible explanations based on hydration shapes and ion-chain interactions will be discussed. In this paper, we also present effects of ion mixtures: Li^+/K^+ and Li^+/Mg^{2+}. The results show that small amount of slow moving ions increases the response time drastically. The experiments also show that the Mg^{2+} ions are trapped in the polymer films and influence electroactivity of conjugated polymers.

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Xuezheng Wang
Department of Mechanical Engineering, University of Maryland, College Park

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