Abstract Submitted
for the 4CF13 Meeting of
The American Physical Society

Investigation of the cycling stability of an ionically-gated organic thin-film transistor JACOB FRIEDLEIN, ROBERT MCLEOD, SEAN SHAHEEN, University of Colorado - Boulder — We have fabricated organic thin film transistors (TFTs) using a film of poly(3,4 ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) as the transistor channel. In its positive oxidation state, PEDOT:PSS is a highly conductive organic semiconductor; however, when it is reduced to its neutral state, its conductivity decreases by many orders of magnitude. We have used this redox switching behavior of PEDOT:PSS as the basis for the modulation of channel current in our (TFTs). When positive ions are driven by a gate voltage into the transistor channel, they interact with the PSS anions, displacing them from the PEDOT, and ultimately reducing the PEDOT to its non-conductive state. Because these devices can operate with gate voltages $<$ 2V and because they utilize ions, they are ideally suited for biological interfacing. In this work, we demonstrate that the redox switching of PEDOT is irreversible in some operational regimes, and we investigate the correlation between device lifetime and the ON/OFF ratio of the channel current. Finally, we explicate the implications of these behaviors on several applications for ionically-gated transistors.

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Date submitted: 21 Sep 2013 Electronic form version 1.4