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Topic: Time Series Analysis Preference: Oral

Analysis of the Humidity Dependence in the Current Through PEG-Si Thin Films by Time Series Methods

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The irregular current characteristic of the polymer Polyethylene Glycol (PEG-Si) under varying humidity is studied in this work. When water molecules penetrate into a polymer sample, the macromolecular chemical chains arrange themselves to form new phases. In previous studies it has been suggested that, after reaching a certain humidity level, a phase transition occurs from a semi crystalline state to a gel state, causing sudden decreases and increases in the current [1]. Water molecules penetrating the PEG samples increase conductivity by binding hydrogen bonds to polar groups. After crosslinking with Gamma-isocyanatopropyltriethoxysilane and mixing the sample with various percentages of Perfluoroalkylethyalcohol (PAF) to obtain pure hydrophobically modified PEG-Si thin Films, we analyzed the current through a thin film of the sample for chaoticity. Different regimes of conductivity result from different types of contributions of water molecules to the hosting PEG or PAF samples. The characteristic and seemingly unstable behavior of the current as a function of increasing humidity, suggested the possibility of chaotic behavior probably by the intermittency route and inspired us to apply non-linear time series analysis on the current measurements[2]. The Lyapunov exponent increases with increasing relative humidity until the relative humidity reaches the constant value at 72% for samples of different hydrogen and alcohol percentages. This value is consistent with the reported value for the phase transition from the semi crystalline state to the gel state. [1, 3]. In order to confirm our suggestion of changing regimes due to the different binding modes of the water molecules, we used detrended fluctuation analysis and observed different slopes for pure PEG-Si[4, 5]. Hydrogenated and Hydrophobically modified PEG samples show different behavior in the Lyapunov exponents for all data sets [6]. Pure PEG samples lose current stability after 72 % but Hydrogenated and Hydrophobically modified PEG samples retain the stability of Lyapunov exponents and detrended fluctuation analysis produces no change in slope, confirming that correlation properties do not change [3].

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