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Non-Equilibrium Water-Glassy Polymer Dynamics
ERIC DAVIS, Drexel University, MATTEO MINELLI, MARCO BASCHETTI, GIULIO SARTI, Universita di Bologna, YOSSEF ELABD, Drexel University — For many applications (e.g., medical implants, packaging), an accurate assessment and fundamental understanding of the dynamics of water-glassy polymer interactions is of great interest. In this study, sorption and diffusion of pure water in several glassy polymers films, such as poly(styrene) (PS), poly(methyl methacrylate) (PMMA), poly(lactide) (PLA), were measured over a wide range of vapor activities and temperatures using several experimental techniques, including quartz spring microbalance (QSM), quartz crystal microbalance (QCM), and time-resolved Fourier transform infrared-attenuated total reflectance (FTIR-ATR) spectroscopy. Non-Fickian behavior (diffusion-relaxation phenomena) was observed by all three techniques, while FTIR-ATR spectroscopy also provides information about the distribution of the states of water and water transport mechanisms on a molecular-level. Specifically, the states of water are significantly different in PS compared to PMMA and PLA. Additionally, a purely predictive non-equilibrium lattice fluid (NELF) model was applied to predict the sorption isotherms of water in these glassy polymers.

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