Diffusivity of single fluorescent probes embedded in thin polymer films

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Photophysics and photochemistry in polymer science has been central areas of interest in understanding the structure and dynamics of polymers. The physical properties of polymers especially the dynamical properties close to the phase transition from rubbery to the glassy state are complex and have not been completely understood despite experimental and theoretical studies over the past decades [1]. Understanding the dynamics of polymer nano environments is highly crucial for numerous technological applications in various industrial and biomedical sectors related to protective and functional coatings and biocompatibility of medical implants [2]. The diffusivity of single probes embedded in thin polymer films can exhibit unusual physical properties due to geometric constraints imposed by the presence of surfaces and interfaces and using single molecule fluorescence microscopy as an imaging technique, allows one to look at the microscopic processes on the nanometer scale [3]. For this research single nanoparticles were embedded in thin polystyrene (PS) and poly (isobutyl methacrylate) (PIMA) films, some of these polymeric films were relaxed and the others were non-relaxed in order to study nano scale polymer dynamics that affect the diffusivity of the single nanoparticles. The diffusivity of the single nanoparticles helps to study the molecular dynamics in thin polymeric films and how these molecular dynamics are related to the glass transition of the thin polymer films. The molecular dynamics include the relaxation processes in polymers such as the α-relaxation, which is believed to contribute to the heterogeneity motion of the single nanoparticles as the temperature of the polymer film is increased towards the glass transition temperature.

