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**Molecular Weight and nanoparticle size dependence of Nanoparticle embedding into Glassy Polymer films** DONGPING QI, MARK ILTON, JAMES FORREST, dept. of Physics and Astronomy, University of Waterloo — We present a study of nanoparticle embedding into polystyrene films over a range of temperatures both above and below the glass transition temperature . In this study we vary the nanoparticle size to examine the effect of probe size scale on the apparent viscoelastic properties. Utilizing polymers of different  $M_w$  reveals a surprising dependence of the embedding lifetimes on polymer size. These studies suggest new evidence for a reduced entanglement density near the polymer free surface. Collectively the results indicate nanoparticle embedding may provide a new probe of entanglements in thin polymer films.

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