

Abstract Submitted
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Intrinsic Friction Microscopy DANIEL KNORR, RENE OVERNEY

— A novel scanning probe methodology based on lateral force microscopy is presented wherein kinetic friction measurements, obtained as a function of velocity for various temperatures, are used to deduce apparent Arrhenius-type activation energies for surface and subsurface molecular mobilities. Depending on the coupling strength (cooperativity) between molecular mobilities involved the dissipation energy can carry a significant entropic energy contribution, accounting for the majority of the apparent Arrhenius activation energy. The intrinsic friction methodology also provides a means of directly separating enthalpic energy contributions from entropic ones by employing absolute rate theory. As such, the degree of cooperativity in the system is readily apparent. This methodology is illustrated with nanoscale tribological experiments on two systems, (1) monodisperse, atactic polystyrene and (2) self assembling molecular glassy chromophores. In polystyrene, dissipation was found to be a discrete function of loading, where the γ -relaxation (phenyl group rotation) was recovered for ultra low loads and the β -relaxation (local backbone translation) for higher loads in the same temperature range, indicating sensitivity to surface and subsurface mobilities. For self assembling glassy chromophores, the degree of intermolecular cooperativity was deduced using the methodology, resulting in an increased understanding of the interactions between self assembling molecules.

Daniel Knorr

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