I will describe two projects in which we characterize complex systems – supercooled liquids and conjugated polymer aggregates – through single molecule or single particle fluorescence imaging. First, in supercooled liquids – systems that display behaviors consistent with the presence of heterogeneous dynamics – we investigate the time scales over which heterogeneities persist using “ideal” single molecule fluorophores. We show that two supercooled liquids, one composed of small molecules and one of polymers, are ergodic down to the glass transition temperature. These studies also reveal the range of time scales over which, for example, fast molecules become slow and vice-versa as well as how these time scales vary with temperature. While these measurements resolve some apparent discrepancies between earlier single molecule measurements and ensemble measurements characterizing time scales of heterogeneity, some remain outstanding. While in supercooled liquids, single molecule fluorophores serve as guest reporters of the surrounding host, to interrogate conjugated polymers, we have developed single molecule and single particle techniques using the fluorescence from the molecules of interest themselves. First, we employ super-resolution techniques to localize individual emitters along prototypical single conjugated polymers, revealing that molecules with compact conformation have distinct photophysical properties from those with extended conformation. Towards understanding photophysical behavior of such molecules in the context of their environment as it exists in devices, we develop a multi-modal approach in which we can elicit and monitor bottom-up growth of aggregates from single chains. Real time monitoring of the aggregates during growth demonstrates that aggregate assembly occurs through multiple mechanisms that have distinct and strong impact on the evolution of physical and optical anisotropy of the aggregates.

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Refreshments will be available prior to seminar at 10:45 a.m. in the Shain Atrium

Graduate Students can meet with the speaker in Room 8305F at 1:00 pm