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### **Tailoring Polymer Nanocomposite Properties by Nanoparticle Assembly<sup>1</sup>**

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Novel materials based on polymer-grafted nanoparticles (NP) are the focus of this talk. Since inorganic NPs and organic polymers typically “dislike” each other, these “hairy” particles behave like block-copolymers or amphiphiles. They can, therefore, self-assemble into a range of superstructures when placed in an organic matrix. Understanding the factors controlling this assembly state and how it affects the properties of the resulting material are our central interests in this area. As part of this global effort, here we address three questions: (i) Can we direct NP assembly using external fields, e.g., shear, with the ultimate goal of designing membranes with directional transport properties? (ii) Can we assemble grafted NPs at interfaces with the aim of compatibilizing immiscible polymer blends? (iii) Can NP assemblies result in simultaneous improvements in the Young’s modulus, the yield stress and strain-to-break of an amorphous polymer in the solid-state? As with all of our work we combine theory and experiments to understand these concepts that underpin our nascent understanding in this area.

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