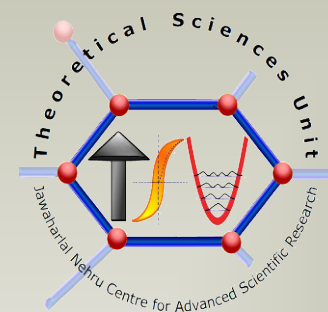




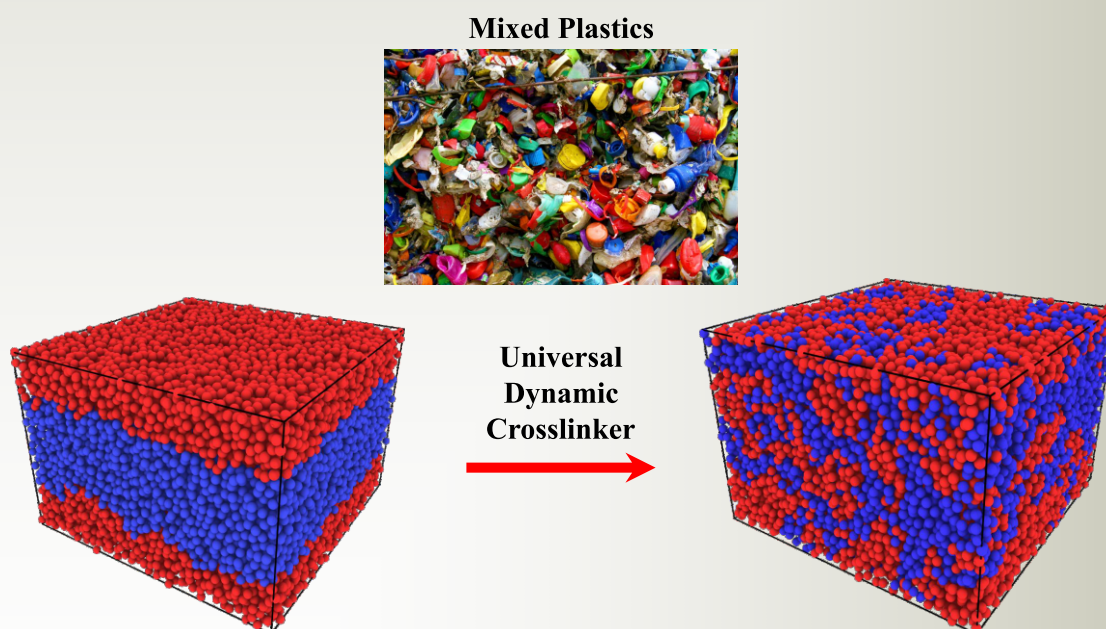
Modeling the Recycling of Polymer Waste



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The fundamental issue underlining the difficulty of recycling polymers is that the free energy of polymerization is strongly favorable – thus, reversing this process to create monomers is energetically unfavorable, and hence economically not viable. A metric that characterizes this difficulty is the ceiling temperature, T_{ceiling} – above T_{ceiling} depolymerization processes are thermodynamically favorable. Thus polyethylene with $T_{\text{ceiling}} \approx 610^\circ\text{C}$ is hard to recycle while polyethyleneterephthalate with $T_{\text{ceiling}} \approx 300^\circ\text{C}$ is much easier. We shall thus discuss different strategies that can facilitate this key process for families of polymers – in all cases our approach is to combine numerical simulations with back of the envelope calculations to understand experimental results. The ultimate goal is to devise family specific schemes that can bring us closer to the ideal of a circular carbon economy.



Sanat Kumar is the Bykhovsky Professor of Chemical Engineering at Columbia University, USA. His research spans experimental, computational, and theoretical studies of soft condensed matter systems, especially synthetic polymer materials. He creates, analyzes, and models new classes of polymer-based hybrid materials with improved properties in compelling applications. Foundational discoveries have focused on controlling inorganic nanoparticle assembly in organic polymers--a holy grail in this field. Driven by these discoveries he has considered hybrid

constructs for use in structural applications such as in ultra-strong building materials (with these constructs being inspired by nacre, the inside coating of an oyster shell), in gas separations (relevant to carbon capture and sequestration), ionic separations (relevant for batteries), and water desalination. His very recent interests are on the upcycling of polymers with the goal of mitigating the explosion of microplastic waste in the environment.



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