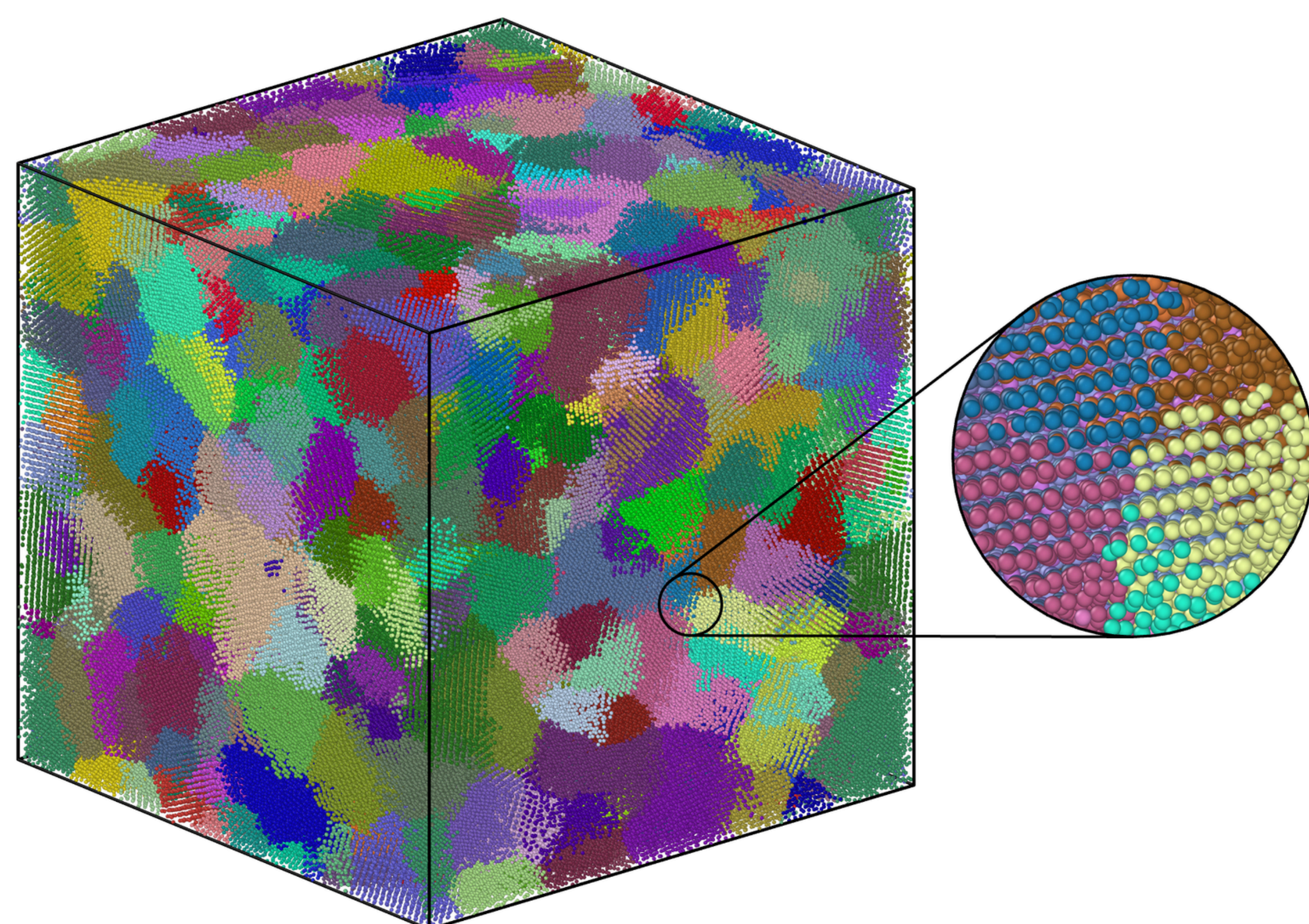


# DR. FRANCIS STARR

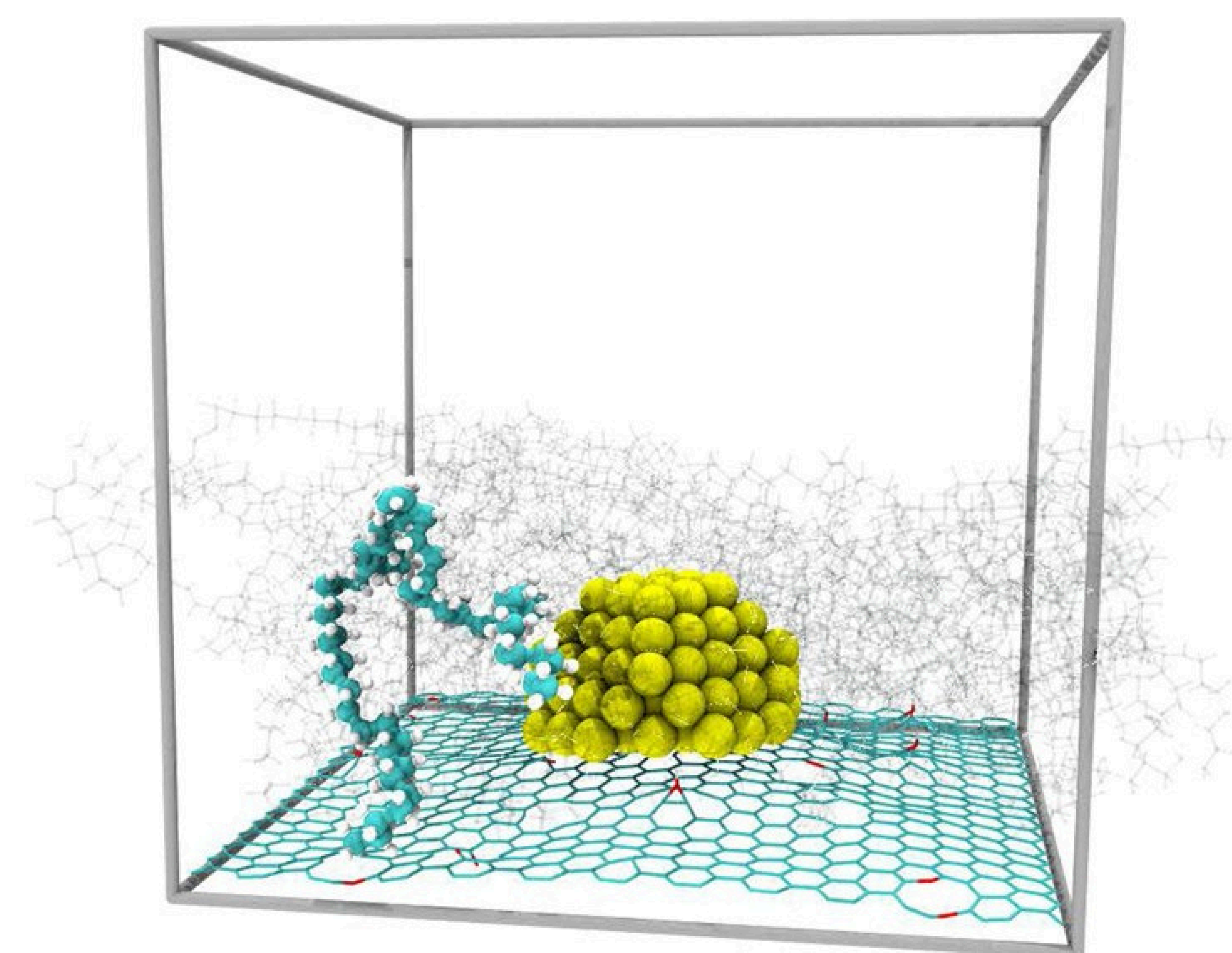
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## Computational Materials Science Lab

Prof. Francis Starr's research group uses computational modeling to explore emerging challenges in soft matter and materials physics. Prof. Starr's research group currently focuses on several distinct but related projects. (i) First, they study the properties of the phase change materials, such as  $\text{Ge}_2\text{Sb}_2\text{Te}_5$  (GST). These materials can store memory as they change structure, allowing for rapid writing of computational memory. (ii) Motivated by the need to improve plastics recycling, they also study how dynamic linkages alter the miscibility of blended polymers. (iii) They study collective motion in crystals and amorphous materials to explore how the motion relates to defects and melting. (iv) The insights gained from these models are being applied to novel materials such as graphene, silicon, and other technologically important amorphous and crystalline solids.



**Above:** Structure of the phase change material  $\text{Ge}_2\text{Sb}_2\text{Te}_5$  (GST) after spontaneous crystallization. Different colors indicate grains with different crystal orientations. GST is valuable for creating non-volatile solid state memory and thermal camouflage.



**Above:** Depolymerization of polyethylene (PE) using a platinum nanoparticle supported on a graphene-oxide substrate. This depolymerization is a key step in chemical recycling methods of plastics.

In the past, Prof. Starr's group has explored the underlying physics of water, polymers, lipid membranes, and DNA, with their specific projects varying over the years. They study amorphous solids, that, unlike mathematically-predictable and symmetrical crystalline solids, have no set order/arrangement. While crystalline solids have predictable behaviors that can be solved via their symmetries, amorphous solids do not—thus, the lab must employ other methods to analyze these materials. Now, they use machine learning to train and build potential models of these materials. The theoretical work that Dr. Starr's research group performs focuses specifically on using these models to answer fundamental questions about amorphous materials and their potential applications or behaviors.