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**Morphologies in Semi-Crystalline Precise Acid- and Ion-Containing Polymers**

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For over a decade we have endeavored to quantify the morphologies in ion-containing polymers using a combination of X-ray scattering and electron microscopy methods. We are motivated by the promise that when we know the polymer physics connecting chemical structure, nanoscale morphology, and physical properties, new strategies for improving polymer properties will be evident. This is particularly challenging in semi-crystalline polymers. Recently, we have been exploring the morphologies in precise acid copolymers and in the ionomers made neutralizing these precise copolymers. The precise copolymers are synthesized by Prof. K. Wagener's group at the University of Florida using acyclic diene metathesis and have functional groups attached to every 9th, 15th or 21st carbon along a linear polyethylene molecule. The precision of these molecules gives rise to well-defined hierarchical structures including acid-decorated polyethylene lamellae and acid or ionic aggregates arranged on cubic lattices. The temperature dependence of these polyethylene-based copolymers is dominated by the crystallization of the polymer. Stretching these materials can induce anisotropy that has facilitated our determination of these hierarchical morphologies and plans are underway to initiate in situ tensile deformation and X-ray scattering to probe the dynamic morphology.