

Polystyrene Nanoparticles Perturb Lipid Membranes

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Abstract

Polystyrene is abundant in marine debris. Like most synthetic polymers, it degrades very slowly, producing smaller and smaller particles easily ingested by wildlife. The presence of plastic microscopic particles in fish and marine wildlife is massive and well documented, but its impact on cellular activity is not understood. Biological activity generally requires interaction with biological membranes, but this is difficult to study at the molecular scale in vivo. Here we use coarse-grained molecular simulations to determine the effect of nano-sized polystyrene (PS) particles on the properties of model biological membranes. We find that PS nanoparticles permeate easily into lipid membranes. Dissolved in the membrane core, PS chains alter membrane structure, significantly reduce molecular diffusion, and soften the membrane. Moreover, PS severely affects membrane lateral organization by stabilizing raft-like domains. Changes in membrane properties and lateral organization can severely affect the activity of membrane proteins and thereby cellular function.

