



UMD Department of Chemistry & Biochemistry
Fall 2021 Seminar Series
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3:00 p.m. ~ Chem 200

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Why Does Plastic Yellow as it Ages??

Many polymers yellow as they age. Polymer aging with resultant chemical changes to the macromolecule is generally attributed to oxidation pathways, particularly for polyolefins. Because of the basic subunit nature of polymers, the chemical byproducts generally have little to no spectroscopic response in the visible region of the electromagnetic spectrum, yet we readily perceive old plastics as yellow. In fact, this discoloration is a hallmark to the integrity of a plastic but there is no physical explanation that can describe the origin of this yellowing. Here we show that irradiated blown polyethylene sheets preferentially scatter circularly polarized light. Because scattering of polarized light only occurs in the presence of chiral structures, our findings provide evidence of formation of chiral supramolecular structures responsible for preferential light scattering, the result of which is the appearance of a yellow/brown tint as the polymer ages. Further, we demonstrate incident polarization dependent detection of colored light scattering from irradiated polyethylene films. Finally, we show that the scattered light is distinctly different in color. Overall, these results provide evidence that the yellowing of polyethylene, previously assumed to be caused by polymer backbone rearrangements, is actually the product of chiral, optically active nanostructures that form on the plastic's surface due to UV irradiation. To the best of our knowledge, this is the first explanation for polymer discoloring that considers the development supramolecular structures of polymers during aging.