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Self-Destructing Polymers: Creating Thermally Sensitive End-Caps

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A broad and booming field of research and innovation, polymer science blends chemistry, physics and engineering and breeds countless modern materials and devices. Likewise, the degradation of these polymers is a field of interest due to the consideration of environmental, medical and economical factors. Nowadays, conventional biodegradable polymers degrade, but require an enzyme to cleave every single connection between monomers before complete disintegration. Numerous stimulus events are thus necessary, promoting inefficient and slow environmental degradation that can take weeks to years.

To address this, the Trant Team is developing a new class of polymers that self-destruct “on-demand” using organic chemistry. Only one stimulus event, removing the end, destabilizes the polymer, which leads it to quickly disintegrate in only a few hours. These self-immolative polymers hence need ends with a functionality that can be triggered, as the “push” required to initiate the domino-like effect. In our case, this push is an elevated temperature that causes the end-cap to destabilize and degrade. Elevated temperatures can be induced via intersecting laser beams or magnetic fields to create heat in desired areas. In addition, the optimal temperature for the degradation of each end-cap will be determined through kinetic studies.

Ultimately, specific reversible chemical reactions will be exploited to create such thermally-sensitive end-caps, allowing “on-demand” degradation of the polymer’s constituents by elevated temperatures. Accordingly, this innovation could potentially lead to endless possibilities and applications, including therapeutic, pharmaceutical, and biomedical applications. At this stage, however, it is too early to report findings as research and data collection are currently in progress. In spite of this, the presentation will review our preliminary results with this technology as well as shed light on its various potential applications.