Rapid degeneration of Polymers and it's Applications

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Abstract

Self-immolative polymers, materials that spontaneously depolymerize monomer unit by monomer unit at room temperature, have been developed only over the past decade. These molecules can be stabilized indefinitely simply by attaching an “end-cap” to one end of the polymer after it is made. When this end-cap is removed, the polymer degrades completely over a period of hours or days-only one bond needs to be broken, the polymer breaks the rest by itself. This is in stark contrast with traditional biodegradable polymers that require an enzyme to cleave ever single bond between ever monomer unit in the polymer. That is why biodegradable materials take months or years to degrade.

However, this rapid degradation is not the most interesting thing about these special polymers. By carefully choosing the structure and nature of the end-cap, the stimulus that is used to remove it (and hence degrade the polymer) can also be easily changed without needing to change the basic nature of the polymer backbone. Previously used stimuli include light, heat, reduction, oxidation, and pH. Unfortunately, many of the polymers made to date are made from highly toxic materials, and are not ever going to be suitable for promising nanoparticle drug delivery applications. This would involve adding a very toxic drug to a nanoparticle made from a self-immolative polymer. In its best iteration, the polymer degradation would be stimulated by an enzyme only found in a cancer cell or bacterium, and would release its drug directly at the target.

The Trant Team is looking to solve this toxicity problem by making these polymers out of amino acids. This presentation will introduce this fascinating class of innovative smart materials, and will discuss the progress we have made towards their preparation and characterization.