Smart 2-Oxazoline Materials Beyond Cationic Ring Opening Polymerization: From Molecular Design to Advanced Applications

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Smart materials have had a tremendous impact in the last decades across a wide range of scientific and technological areas.[1] Their capacity to modify their structure and properties in response to various internal or external stimuli has enabled significant progress in energy storage, sensing, environmental protection, advanced manufacturing and biomaterials.[2] Moreover, such materials represent the precursor of truly living materials so called "animate" materials. Ideally, these materials can change their properties or perform actions, often by taking energy, material or nutrients from the environment; can sense changes in their environment and respond; and are autonomous, being able to initiate such a response without being controlled.[3] Despite major advances in the synthesis of smart biomaterials a completely autonomous material has yet to be created.

In this respect, poly(2-isopropenyl-2-oxazoline) (PiPOx), has attracted increased scientific attention as a reactive polymer for the synthesis of advanced functional materials.[4] PiPOx is a versatile polymer soluble in water and various organic solvents, can be prepared with well-defined characteristics, and exhibits high thermal and good hydrolytic stability.[5, 6] Furthermore, PiPOx was shown to be biocompatible, rendering it suitable for medical and pharmaceutical applications.[4] The pendent 2-oxazoline group can be transformed in an efficient, mild, and selective manner, providing an extremely valuable toolbox for the synthesis of advanced materials. The post-polymerization modification reaction with (di)carboxylic acids enables access to a wide variety of structures with defined and controlled properties. The versatility of this modification method allows the synthesis of a wide variety of functional polymers with tunable properties from soft to hard materials.[7-11]

Recent developments from our research group that illustrate the potential of PiPOx as smart (bio)materials will be discussed in this lecture, ranging from fundamental studies on ring opening addition of PiPOx with carboxylic acids to emerging applications of these polymers as biomaterials, nanosensors, drug delivery vehicles and biohybrid nanofibers.

References:

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