Biomaterials Made from Natural Compounds: From Dental Resins to Shape-Memory Polymers

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Natural compounds such as bile acids can be used in the preparation of a variety of new polymers for biomedical and pharmaceutical applications. Bile acids are natural amphiphilic compounds that exist in the gastrointestinal tract and help in the digestion of fat by the formation of micellar aggregates. Their facial amphiphilicity, acid-base properties and the ease of chemical modifications make them interesting candidates in the preparation of polymeric biomaterials, which are expected to exhibit better biocompatibility and bioacceptance. Dental monomers have been made from bile acids by attaching multiple polymerizable double bonds to the biocompounds. They have shown lower cytotoxicity and lower polymerization shrinkage than the commonly used dental monomers. High molecular weight homo- and copolymers based on bile acids were synthesized via entropy-driven ring-opening polymerizations and were found to display tunable mechanical properties and heterogeneous degradation behavior. The main-chain bile acid-based polyesters obtained display typical rubber-like elasticity behaviors with elongation moduli closely matching those of soft tissues such as arteries and cartilage. The polymers are amorphous in nature and some display interesting shape memory properties without any chemical crosslinking. In addition, multi-shape memory copolymers were prepared through copolymerization of norbornene derivatives of cholic acid. The polymer displayed good shape fixing and recovery in different thermal processing stages over the broad glass transition range, making them useful as functional materials.

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