

Design of photoresponsive polymer based on multiscale analysis

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In broad terms, photomechanical phenomenon refers to mechanical deformation as a response to irradiation of light. The phenomenon is inherently multiscale, since driving force is a chemical change of light sensitive molecules in the polymer, while the deformation is macro-scale, often few centimeters. Present study contains two branches of discussion; analysis and design. In an analysis part, a material containing light-sensitive molecules is investigated through sequential multiscale analysis based on quantum physics, molecular statics (MS) and continuum mechanics with geometrical nonlinearity. This study reveals that photoresponsive polymer bend and twist as light is irradiated onto the specimen. In a design procedure, the material is designed to deform into desired topological shape such as sphere and oval, to provide solutions in the field of drug delivery and micro-actuator research.

Keywords: Photoresponsive polymer, Corotational formulation, Multiscale analysis, Optimization