

Abstract/Summary

In this thesis we explore soft polymeric materials that can be steered by light – quite literally. Through illumination in suitable settings, these materials cannot only be modulated for example in terms of softness, but they can be brought to physically deform, meaning they change shape. The directionality and amplitude of such effects lying largely in the hands of the experimenter, a wide playground of new technological scenarios and cascading effects is explored. Acknowledging the decade-spanning efforts to elucidate the photo-deformation properties of azopolymers in fixed and quasi-static situations, we focus particularly on dynamic situations where the light-fueled system interacts, or hopefully will be capable to interact, with other components of a device or its environment. During this endeavor, we encounter a range of open-ended questions relating to the maximal size of actuating structures, the possibility of overwriting previous shape changes, and even the prospect of producing never-ending light-induced motion. The generated insights – for example on interaction effects between light-triggered azopolymer parts of a system and passive elastomer surroundings – may benefit the further understanding of azopolymer photo-deformation on a fundamental level. On the other hand, the systems derived from the pursuit of these questions naturally open for new application scenarios. For example, we introduce light-responsive elastic metamaterials which could serve to steer elastic waves, a soft robotic arm which may eventually be guided towards the manipulation of objects, and a light-controlled particle flow system where propulsion channels can freely be drawn on liquid surfaces. We hope that this approach, together with exciting recent examples from literature, may inspire further work in what could be referred to as azopolymer system design, aiming not only at azopolymers' photo-deformation per se, but also at their study and application as components of more complex systems and devices.