Light-responsive actuators manufactured by 3D printing technologies

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ABSTRACT

3D and 4D printing technologies[1,2] have emerged as innovative methods for designing and manufacturing functional objects, devices and actuators with complex architectures, and additional time-changing shape and properties. Despite such enormous opportunities, current additive manufacturing technologies are still far from being a robust fabrication platform for optical systems.[3] This is especially relevant for fabricating 4D optical components and devices, which might enable a novel class of devices, that are reconfigurable and programmable by external optical signals. To this aim, an engineering of the 3D printing technologies for active and photo-responsive materials[4] is needed, allowing for going beyond the consolidated current printing methods, developed mainly for passive optical materials.

Here, we will review our current work aimed at developing advanced 3D printing methods for objects incorporating photo-responsive molecules. The investigated systems consist of polymer cantilevers printed by fused deposition modelling (Creatr, Leapfrog^{TM}) and functionalized by photochromic molecules. The approach here developed allows for printing mm-scaled levers that can be controlled by utilizing external ultraviolet and visible laser beams, with characteristic actuation times of the order of a few seconds. These results pave the way for a novel class of actuators, which are addressable precisely and remotely by light beams.

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