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Additive Manufacturing as a new opportunity for lightweight Shape Memory Polymers in industrial applications such as robotics or medical surgery

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Shape memory polymers (SMPs) are multifunctional materials that can change their shape under external stimuli, usually temperature, gaining interest in various applications [1, 2]. Particularly interesting is a new generation of multiple SMPs that demonstrate the ability to memorize more than two shapes. The property significantly broadens the functionality of SMPs making them attractive for applications from robotics to biomedicine. The multiple shape memory effect (SME) can be achieved through additive manufacturing (AM), particularly 4D printing. The approach facilitates the design and development of devices with complex structures unattainable by traditional techniques [3].

Thermoset shape memory photopolymer specimens are printed by laser-stereolithography and digital light processing. The investigation of their thermal, mechanical and thermomechanical properties by Discovery TGA 5500, Discovery DSC 250 and Instron 5969 testing machine with thermal chamber is conducted.

Complex-shape SMP actuators with multiple SMEs will be designed, processed by AM technologies and optimized by prototyping facilities and computational modeling (CAD, FEM, topology optimization software). The actuation to trigger the shape change of multiple SMPs is obtained by step-by-step heating to various temperatures.

Lightweight shape-morphing devices for various applications, including minimally invasive surgical devices and smart robotic grippers will be developed and prototyped.

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