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Thermoplasmonics for Light Robotics

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Light Robotics[1] deals with the fabrication and applications of microtools amenable to optical trapping and manipulation. Such microtools, or microrobots, can be fabricated by direct laser writing (DLW) in suitable photoresists. Two-photon polymerization (2PP) is preferred as 3D-printing method, as it allows DLW of structures with a resolution of ~200 nm in commercially available photoresists.

To successfully employ these microrobots in specific applications, different functionalities need to be embedded in the design. This is done primarily by tailoring the shape and surface properties of the microrobots to the desired application.[2] From a technological point of view, one of the simplest ways to selectively functionalize the surface of the 3D-printed microrobots is physical vapor deposition (PVD) of thin metal layers. During fabrication, a mask can be 3D-printed on top of the microrobots to selectively expose only certain portions for ulterior metal deposition.

PVD of thin gold layers on the microrobots enables thermoplasmonic effects upon laser actuation. Our group has recently reported two types of light-controllable microrobots with functionalities that rely on plasmonic heating: syringe-like microtools that exploit the thermoplasmonic effect for loading/unloading[3] and disk-microtools that can be employed to enhance mixing and induce natural convection in microfluidic channels[4]. New applications of thermoplasmonic effects for microrobots are expected to emerge in the near future. This would help expand the uses of the Light Robotics microscale toolbox.

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