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Direct Laser Writing of Ferromagnetic Nickel Structures Utilizing the Principle of Sensitized Triplet Triplet Annihilation Upconversion

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Metallic microstructures have become a topic of great interest for many fields due to their conducting and magnetic properties. Conventional Direct Laser Writing (DLW) is a versatile method for additive manufacturing of microscale polymeric structures. Despite the fact that many applications would benefit from the ability to directly print metallic and especially ferromagnetic microstructures, there have only been a limited number of proposals to take advantage of the benefits of DLW technology for the fabrication of metal structures.
In this talk a novel approach to Direct Laser Writing of metallic materials is presented. For this purpose, photochemical compounds and principles were investigated via different methods and applied in a home-built setup for Direct Laser Writing. A sensitized triplet-triplet annihilation upconversion process (sTTA-UC) is used to generate the energy required for the photochemical reduction of nickel. In order to ensure the sTTA-UC to work efficiently without having to work in degassed media, a photochemically deoxygenating solvent provides a local deoxygenated area upon excitation by a sensitizer to ensure the sTTA-UC to work efficiently. In combination, these three processes offer a new approach to DLW of 2D Nickel structures.
As a proof of concept for this method, Nickel structures with feature sizes down to 200 nm were fabricated and are presented together with an analysis of their materials properties. To investigate the ferromagnetic characteristics of the structures, the emerging technique of nitrogen-vacancy (NV) magnetometry is used.
By closely linking physics to photochemistry and combining the potential of both fields to fabricate and characterize innovative nickel structures, this work represents a major step forward in extending the possibilities of DLW to a wide range of materials.

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