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Foam target structures developed by two-photon polymerization for inertial confinement fusion

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The objective of the french TARANIS project is to develop concepts of design of Inertial Confinement Fusion (ICF) nuclear reactors for clean and safe electricity production. To do so, a maturation phase is necessary, in which several thematics are being studied as for example: laser systems required, determination of promising fusion reaction scheme, or targets design and a way for mass production for these latter. In this work, we will discuss about target production by presenting high-resolution foams produced by two-photon polymerization. This technique uses a femtosecond laser to create 3D structures on a photosensitive resin with layer-by-layer processes [1]. The polymerization only occurs at the laser's focal point, resulting in a very high resolution (~ 200 nm).

To begin with these kind of developments, "logpile" mesh-type foams of variable structure and density, ranging from tens to hundreds of mg/cm^3, have been synthesized. These foams have also been characterized by various techniques, including X-ray tomography, in order to confirm the absence of residual resin and the presence of a regular mesh throughout the foams. To further advance the research, the team is investigating the use of functionalized substrates that allow for easy detachment of samples, as well as preparing for future impregnation tests with liquid deuterium.

References

[1] H. Wang et al., Two-Photon Polymerization Lithography for Optics and Photonics: Fundamentals, Materials, Technologies, and Applications, *Adv. Funct. Mater.*, **2023**, 33, 2214211