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MeV-scale simulations and fabrication tests of woodpile-based waveguide for dielectric laser accelerators

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Hollow-core dielectric Electromagnetic Band Gap (EBG) microstructures powered by lasers represent a new and promising area of accelerator research since, thanks to the short optical wavelength and to the dielectric's high damage threshold greater accelerating gradients, with respect to the metallic counterparts, can be achieved.

In this paper, we present MeV-scale beam-dynamics simulations and fabrication results relative to a silicon, woodpile-based travelling-wave structure operating at the wavelength ⊠0 = 5 µm. The simulated CST and HFSS electric field has been evaluated and used as input for a space charge tracking code, in order to perform beam-dynamics evaluations on the beam injection and extraction into the proposed structure as well as the evolution of the main beam parameters.

We also report on the fabrication of first Si prototypes of the woodpile structure that are obtained by the innovative Two Photon Polymerization fabrication process. This technique allows to reach resolutions down to hundreds of nanometers, offering the possibility to print Si-rich structures, or woodpile skeletons to be infiltrated with Si by CVD technique.

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