WOODPILE STRUCTURE FABRICATION FOR PHOTONIC CRYSTAL LASER ACCELERATION

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Abstract

We present recent progress in the fabrication of a 3D photonic crystal laser accelerator structure. Direct acceleration of electrons by lasers offer promising improvements over traditional RF acceleration techniques in terms of cost, gradient, technology used, and short temporal bunches produced. Microbunching and net acceleration experiments were successfully performed at the E163 facility at SLAC, setting the stage for design, fabrication, and testing of optical structures. This paper describes work done at the Stanford Nanofabrication Facility towards fabricating such structures. A process based on standard optical lithographic techniques was used to fabricate a four layer woodpile photonic crystal with a bandgap centered at 4.55μm and a full width half max of 2.71μm. Infrared spectroscopy measurements were taken and compared with simulations yielding good agreement. SEM images were used to measure fabrication deviations in rod width, rod shape, layer thickness, and alignment, and further simulations are being done to study the effect of these deviations on properties of the accelerating mode excited in the defect of a 20 layer structure currently under design.

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