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Building Novel RF Sources out of Optimized Photonic Crystals
GREGORY R. WERNER, TOBIN MUNSAT, CARL A. BAUER, University of Colorado, JOHN R. CARY, Tech-X Corp. / University of Colorado — RF sources, such as klystrons, use an electron beam to excite a mode of an RF resonant cavity; RF power is subsequently extracted from the cavity. Traditionally RF sources have used metal cavities, which can have higher order modes that disrupt production of the desired frequency; these can be particularly destructive in high-power multi-cavity systems. A cavity in a photonic crystal (e.g., a lattice of dielectric rods in vacuum), however, can be designed to support only a single mode; electromagnetic waves of other frequencies simply pass through the photonic crystal walls. Such a cavity should be ideal for an RF source, since there is only one mode an electron beam can excite. A feasible cavity based on a 2D photonic structure can be created using dielectric rods with metal endplates. Moreover, optimization of the rod positions leads to configurations that break lattice symmetry but yield more practical and better-performing structures. A design for a klystron using RF cavities made out of a small number of sapphire rods and metal end-plates is presented, along with computer simulations of electron beams exciting the cavities.

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