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A 3D hexagonal-packed photonic crystal with a tunable plasma-filled defect. BENJAMIN WANG, OLIVER MILLER, MARK CAPPELLI, Stanford University — In previous studies [1, 2], we demonstrated 1D (slabs) and 2D (square lattice cylinders) aluminum oxide photonic crystal defect tuning using plasma-filled vacancies. In this study, we characterize the electromagnetic response of a 3D hexagonal-packed photonic crystal comprised of 3 mm diameter silicon-nitride spheres (commercial bearings) with a vacancy defect that is occupied by a low pressure He-filled 3 mm diameter hollow aluminum oxide sphere ionized by an AC capacitively coupled discharge. The discharge plasma-filled defect serves to tune the defect state transmission generating an effective tunable microwave filter with relatively high quality factor. We will describe the fabrication of the photonic crystal and associated defect, and comparisons of measured transmission spectra to simulations using ANSYS HFSS and a presumed plasma density. [1] D. Pai, et al, The European Physical Journal D 73 (5), 97 (2019), [2] B. Wang and M.A. Cappelli, Applied Physics Letters 107 (17), 171107 (2015).

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