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Photonic Band Gap accelerator demonstration at Ku-band.

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We report the design, fabrication and high power testing of a high gradient electron accelerator with a photonic band gap (PBG) structure. The photonic band gap structure confines a fundamental TM_{01}-like accelerating mode, but does not support higher order modes (HOM). The absence of HOM is a major advantage of the PBG accelerator, since it suppresses dangerous beam instabilities caused by wakefields. The PBG structure was designed as a triangular lattice of metal rods with a missing central rod forming a defect confining the TM_{01}-like mode and also allowing the electron beam to propagate along the axis. The design frequency of the six-cell structure was 17.14 GHz, to match an available klystron and linac. The absence of HOM was confirmed in cold test. The PBG structure was excited by 2 MW, 100 ns pulses from the klystron. A 16.5 MeV electron beam was transmitted through the PBG accelerator. The observed electron beam energy gain of 1.4 MeV, measured using a magnetic spectrometer, corresponds to an accelerating gradient of 35 MeV/m, in excellent agreement with theory. PBG accelerators are a promising approach to future high gradient accelerators.