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Strong Coupling of Terahertz Cyclotron Resonance with a One-Dimensional Photonic Crystal Cavity MINHAN LOU, QI ZHANG, Department of Electrical and Computer Engineering, Rice University, Houston, Texas, USA, RODION KONONCHUK, ANDREY CHABANOV, Department of Physics and Astronomy, University of Texas at San Antonio, San Antonio, Texas, USA, JUNICHIRO KONO, Department of Electrical and Computer Engineering, Rice University, Houston, Texas, USA — Achieving strong light-matter interaction is essential for the study of cavity quantum electrodynamics. In the ultrastrong coupling regime, where the ratio of the vacuum Rabi splitting to the transition frequency is close to or larger than one, intriguing quantum effects, e.g., the Bloch-Siegert Shift and interaction-dependent ground states, are expected to appear, due to the breakdown of the rotating wave approximation. Since this ratio increases with the transition wavelength, going to the terahertz (THz) range is promising for exploring new strong-coupling phenomena. Here, we experimentally demonstrate strong coupling between the cyclotron resonance of a high-mobility two-dimensional electron gas and a photonic defect mode in a one-dimensional (1D) THz photonic crystal (PC) cavity. Compared to THz cavities based on split-ring metamaterials, the 1D PC cavity exhibits a higher quality (Q) factor and lower loss, in spite of a larger mode volume. Our 1D PC cavities consist of quarter-wave intrinsic silicon / sapphire slabs and air gaps. The Q factor can be tuned in a wide range by changing the materials and the number of layers. An ultrathin modulation-doped GaAs quantum well is placed at the electric field maximum of the defect mode in the 1D THz PC cavity.

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