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Design of an on demand single photon source using a metal-insulator-semiconductor capacitor structure B.H. HU, C.H. YANG, Department of Electrical and Computer Engineering, University of Maryland at College Park, M.J. YANG, Naval Research Laboratory — We propose an on-demand single photon source for unconditionally secure quantum cryptography. Similar to a typical metal-insulator-semicondoctor capacitor structure, the main component in the semiconductor is a p-doped quantum well, and the cylindrical gate under consideration is only nanometers in diameter. This MIS system can be biased to inversion, and, due to the small gate area, there are only a few electrons residing in a quantum dot at the onset of inversion. Considering the strong size quantization and large Coulomb energy, the number of electrons can be precisely controlled by the gate voltage. After holding just one electron in the inversion layer, the capacitor is quickly biased back to the flat band condition and the subsequent radiative recombination across the bandgap results in single photon emission. Using GaAs/AlAs as the model system, we present a numerical simulation of three-dimensional band bending and merits of this single photon source.

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