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Narrow optical line width from site-controlled InGaAs quantum dots LILY YANG, NRC Postdoc Residing at the Naval Research Laboratory (NRL), MICHAEL YAKES, NRL, TIMOTHY SWEENEY, NRC Postdoc Residing at NRL, SAMUEL CARTER, CHULSOO KIM, NRL, MIJIN KIM, Sotera, ALLAN BRACKER, DANIEL GAMMON, NRL — The incorporation of self-assembled quantum dots (QDs) in systematically scalable quantum devices requires a method of nucleating dots with nanometer-scale spatial accuracy while preserving their narrow optical line width. We have developed a technique combining e-beam lithography, wet etching, and molecular beam epitaxial (MBE) growth to deterministically position InGaAs QDs with spectrometer limited photoluminescence line widths. Our technique takes advantage of the anisotropy in GaAs growth to evolve an etched pattern of holes and lines into faceted structures in which dots nucleate. Using this technique, we were able to grow a buffer layer of pure GaAs up to 90 nm in thickness between the processed surface and the dot nucleation surface, effectively separating the QDs from unavoidable residual defects and impurities on the patterned surface that broaden their optical line widths. Additionally, we demonstrate control over the number of dots nucleating per site, from single to a chain of several, by varying the dimensions of the original pattern. Our dots are grown in a Schottky diode structure. Their PL spectrum shows discrete charging transitions, with narrow linewidths near the spectrometer's resolution limit of 20 micro eV.

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