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Ultra-low threshold quantum dot microdisk laser G.S. SOLOMON, Ginzton and Solid-State Laboratories, Stanford University, Z.G. XIE, Solid-State Laboratory, Stanford University, S. GOETZINGER, Y. YAMAMOTO, Ginzton Laboratory, Stanford University, W. FANG, H. CAO, Department of Physics and Astronomy, Northwestern University — Ultra-low threshold lasers have applications in low-power communications. These lasers are also of fundamental interest, where a full understanding of lasing based on a few discrete emitters is evolving. This is especially true in solid-state systems, for instance those with a quantum dot (QD) gain medium, where a typical spectrum of discrete emission lines observed at lower pump power is often highly modified under higher pump powers. Here we discuss a microcavity laser containing a dilute QD gain medium that has an ultra low, sub-microwatt CW lasing threshold. The structure is based on a high-quality factor microdisk cavity of GaAs with a low density of InAs-based QDs embedded in the microdisk. We estimate 250 QDs in the 1.8 μm diameter microdisk under investigation. Of these QDs approximately 60 are spatially located within the modal region of the disk, which extends inwards approximately 250 nm from the disk edge. Only a small portion of these QDs couple to the narrow cavity modes, which have a free spectral range of 45 nm and an initial linewidth of 0.06-0.07 nm. Linewidth narrowing and lifetime reduction with increasing pump are both observed. Despite the small number of QDs it is unlikely from our estimates the system lases from a single QD state.

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