Quantum dot LEDs (QD-LEDs), which capitalize on the excellent color saturation and high photoluminescence efficiencies offered by quantum dots, promise to be part of future generations of display technologies [1]. The goal of our project is to integrate the already developed technology of the QD-LED into a resonant cavity (RC) and thereby achieve enhanced, directed electroluminescence (EL) that can be of use in fields as diverse as optical communications, spectroscopy, and environmental and industrial sensing.

The RC structure we are currently investigating (Figure 1) consists of a standard QD-LED [1] grown on top of a distributed Bragg reflector (DBR). A DBR is a highly reflective mirror made of $\frac{\lambda}{4}$ layers of alternating high and low indices of refraction. With a reflectivity of more than 98% in the wavelength region of interest, the DBR serves as one of the cavity mirrors. The other cavity mirror is the Ag doped Mg electrode of the QD-LED. With this structure, we have achieved narrowed emission, which is evident when comparing EL spectra and images of the QD-LED and the RC QD-LED (Figure 2). The QD-LED appears orange because our eyes sense the red light of the QDs as well as the shorter wavelength emission from the organics. In contrast, the RC QD-LED exhibits effectively monochromatic red light. The plot of peak emission intensity at different angles (Figure 2) shows an emission cone of less than twenty degrees. If the path-length of the cavity does not match the QD emission wavelength, EL from the RC QD-LED is off-normal. We are currently working to understand the emission enhancement capability of our RC QD-LED.

References