The optical cavities with GaN nanodisks were investigated by a room temperature photoluminescence evaluation (RT-PL) and a two-dimensional finite difference time domain method (2D-FDTD). The GaN nanodisks were fabricated by radio-frequency plasma-assisted molecular beam epitaxy. The SEM images of the nanodisk are shown in Fig. 1(a) and 1(b), the side length of the hexagon was 300 nm. The RT-PL spectrum taken under the excitation by a nitrogen laser with a wavelength, a repetition rate, and a pulse width of 337.1 nm, 10 Hz, and 900 ps, respectively, is shown in Fig. 2. It contained a sharp emission peak, indicating that the nanostructure worked as an optical cavity. In addition, the 2D-FDTD was employed to calculate the light distribution in the nanodisk. The result shows that the whispering gallery mode [1] is dominant in the nanodisk as the optical cavity, as shown in Fig. 3. These results indicate that the GaN nanodisk has potential to realize a nanolaser in the ultraviolet to visible wavelength region with combination of other III nitride families.

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Fig. 1. (a) Bird’s-eye view and (b) top view SEM images of the GaN nanodisk. 
Fig. 2. The RT-PL spectrum obtained from the GaN nanodisk. 
Fig. 3. The electric-field distribution in the nanodisk calculated by 2D-FDTD.