

The modes of the L3 defect cavity in GaAs photonic crystal membranes

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The L3 defect was the first type of photonic crystal cavity structure in which experimental quality factors significantly greater than $Q \sim 10^4$ were obtained. Research on these structures has focused on the lowest energy, high Q mode, and optimising it by perturbing the holes around the defect, mainly shifting those at either end. However the cavities also support a number of other modes within the fundamental TE band-gap. We investigate the properties of both the fundamental and higher modes in GaAs structures, using polarisation dependent photoluminescence measurements and numerical modelling of the emission in the far-field. Our results show that there is a strong change in the emission pattern for the optimised structures, corresponding to a cancellation of the dipole part of the emitted field. We also show that shifting the end holes can lead to a reordering of the modes, related to their field distributions, and a significant increase in the Q of a second mode.