

Part I

**Development of Ultrasmall Volume,
High- Q Photonic Crystal Microcavities**

The first part of this thesis details work on planar photonic crystal microcavities. Chapter 1 discusses two semi-analytic tools for studying modes within these structures, while chapter 2 reviews a methodology for design of high quality factor cavities, and presents cavity designs within different photonic crystal lattices. Finally, chapters 3 and 4 describe the experimental implementation of these designs within an InP-based multi-quantum-well material and within silicon, respectively. The former chapter presents photoluminescence measurements of the InP-based devices, while the latter chapter utilizes an optical fiber taper waveguide to passively probe the properties of the silicon resonators.