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Abstract

Photonic crystals allow light to be controlled and manipulated such that novel photonic devices can be created. We are interested in using photonic crystals to increase the energy efficiency of our semiconductor whistle-geometry ring lasers. A photonic crystal will enable us to reduce the ring size, while maintaining confinement, thereby reducing its operating power. Photonic crystals can also exhibit slow light that will increase the interaction with the material. This will increase the gain, and therefore, lower the threshold for lasing to occur.

Designing a photonic crystal for a particular application can be a challenge due to its number of parameters and features of interest. A genetic algorithm evolves solutions around the constraints of the application until the fittest solution is found. We are optimizing our crystal structures to maximize their bandgaps. However, our designs are using dielectric materials to fill any holes which lowers the refractive index contrast and bandgap for a given design. Our unique approach is to integrate several materials and sample the various permutations within the genetic algorithm. Thereby, allowing for complex structures with larger bandgaps to arise. Here we present our successful preliminary findings that show a large complete bandgap can be achieved despite a relatively low index contrast.