Photonic bandgap (PBG) structures have received a great deal of attention recently for their potential applications in photonics. These structures can achieve very strong mode confinement, as well as high dispersion within minimal path length, and thus may allow complex optical circuits to be achieved of very small area. A critical issue, however, has been to obtain practical PBG devices with low excess losses. The small dimensions and inherent three-dimensionality of the periodic features make precise definition difficult, and this, combined with the resonant nature of the optical interaction, has tended to result in unacceptable insertion losses.

Although PBG structures in III-V semiconductors allow active functionality to be incorporated, silicon has significant advantages for passive devices such as filters. In particular, etching techniques for silicon are superior to those for III-V’s. Inductively coupled (deep) plasma reactive ion etch processes (DRIE) allow photolithographic patterns to be projected through tens or hundreds of microns into silicon with excellent sidewall verticality. Meanwhile, anisotropic wet etching can create finished Si surfaces of atomic smoothness.

In this paper we describe the development of silicon PBG structures for application in tuneable photonic filters. The use of bonded silicon on insulator substrates allows the definition and release of electrostatic (MEMS) actuators, with the bonded layer also defining the depth of the PBG features, which are initially fabricated by DRIE. The use of DRIE allows the transfer of complex 2D patterns from the surface without the unwanted features which result from anisotropic wet etching. However, insufficient surface smoothness and verticality is obtained. Hence, we have developed a technique in which a brief anisotropic wet etch is carried out on the PBG structure after DRIE, using a bonded Si layer of \langle 110 \rangle orientation. We show that this results in a fibre pigtailed device with low insertion loss.