Lithography Limits of Photonic Crystals

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The creation of high quality photonic crystals requires very demanding lithography. Accurately creating structures with the desired spectral response can be very challenging, especially for devices such as high-Q cavities [1]. The importance of disorder in photonic crystals is also very important [2]. It has recently been shown that losses in photonic crystal waveguides increase with increasing disorder [3].
The overall disorder may be considered to consist of positional disorder- due to variations in the hole spacing, and size disorder- due to variations in the hole size. Both of these largely originate in the initial lithography stage, (though subsequent processing steps are also important).

In this work, we look at the methods of minimising disorder and improving the general quality of two-dimensional photonic crystals through an improved understanding of electron beam lithography for pattern definition. The effects of the various machine parameters such as step size, digital resolution and beam drift and software related issues such as proximity correction are examined. The subsequent effects on the optical quality of the final device are determined.

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[3] D. Gerace, and L. C. Andreani, *Optics Letters*, **29**, 1897 (2004).