

Inverse design beyond photonic crystals - An introduction to Scattering Optical Elements

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The challenge of making artificial photonic crystals has developed many top of the art fabrication methods. Many of these methods such as lithography or micromanipulation, are so complete that they are not only restricted for crystal fabrication, but also being able to introduce very complex defects into otherwise ordered structures. Taking advantage of this freedom of design one can push this to its extreme creating optimized free-form structures by breaking the symmetry and introducing an excessive number of defects. Within this framework we have established a new type of optical devices named Scattering Optical Elements (SOE) [1]. SOEs are inverse designed optical components where each scatterer is placed in an optimized position with respect to a chosen functionality. The universality of the design approach makes it very straight forward to do component 'design on demand'. So far a small library of new innovative and high quality devices has been proposed, e.g. optical lenses [2], de-multiplexers [1,3] and spontaneous emission controlling elements [4].

[1] A. Håkansson et al., Appl. Phys. Lett 87, 193506 (2005)

[2] L. Sanchis et al., Appl. Phys. Lett. 84, 4460 (2004)

[3] A. Håkansson et al., Opt. Express 13, 5440 (2005)

[4] A. Håkansson et al., Phys. Rev. Lett 96, 153902 (2006)