Enhanced digitalization technique for photonic structures generated to support a localized field in the continuous part of the spectrum

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In this work, we take advantage of the close analogy that exists between quantum mechanical and electromagnetic phenomena [1-3]. By starting from the modified form of the Helmholtz equation for the electric field, which is analogous to the Schrödinger equation (and so are their general solutions), it is possible to construct complex optical potentials isospectral with the selected initial one. The method used for generating those potential relies on supersymmetric (SUSY) quantum mechanics [4-6]. Each of the complex optical potentials obtained in this manner supports one and only one localized normalizable function of the electric field in the continuum part of the spectrum. Here, we implement the SUSY transform to the case of flat initial optical potential and obtain a smoothly varying complex potential, together with the corresponding electric field function for the localized state. The ultimate goal is to enable practical realization of the final structure, i.e. to construct a realizable photonic crystal with complex permittivity $\varepsilon(x)$ which supports such bound state in continuum. For this purpose we have developed an elaborate scheme of digital grading [7-9], customized to account for the complex nature and the sharp variations of the supersymmetric optical potential. The advantage of this method is that it produces complex relative permittivity function which is constant by parts and can therefore be realized by deposition of layers of homogeneous materials (Fig. 1).

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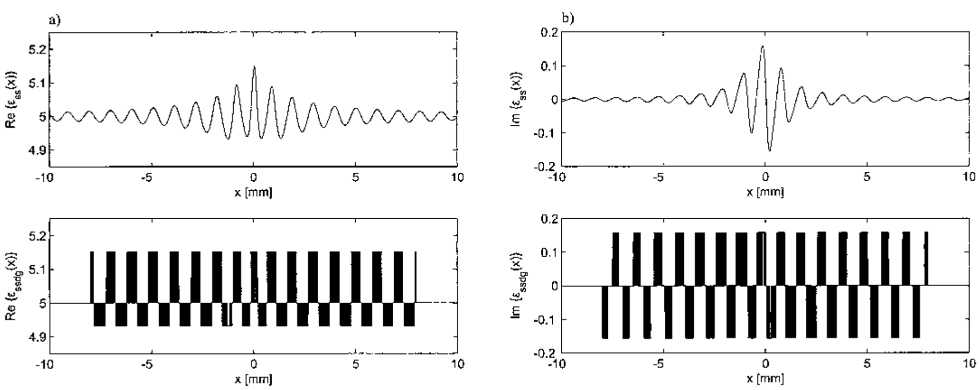

Fig. 1 The results of the digital grading approximation applied to final complex permittivity, for both a) the real and b) the imaginary part of $\varepsilon(x)$

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