Metamaterials and photonic crystals – potential applications for self-organized eutectic micro- and nanostructures

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In recent years, two different types of materials are being developed in the area of photonics: photonic bandgap materials[1,2] (photonic crystals) and metamaterials.[3,4] In photonic crystals, the wavelength of the light has to be comparable to the periodicity of the structure, in order to exhibit a photonic bandgap effect. In metamaterials, on the other hand, the wavelength should be much bigger than the structuring of the matter, since only the effective properties such as effective permittivity and permeability are important. There are many sophisticated methods for obtaining these two types of materials. But they could be also obtained by self-organization. In the present work the self-organized structures are obtained by directional solidification of eutectics. Eutectic micro- and nanostructures are proposed as materials for different types of light manipulation.[5,6] Eutectics present the unusual characteristic of being at the same time a MONOLITH and a MULTIPHASE MATERIAL.[7] They have the potential for optical, electronic and magnetic applications.[8] Their product properties may define metamaterials, since "metamaterials are engineered composites that exhibit superior properties that are not found in nature and not observed in the constituent materials".

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