PHOTONIC GLASSES AS MATRICES FOR RANDOM LASERS

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Self assembly, the bottom up technique to fabricate complex materials architectures, has revealed as a powerful means for the fabrication of photonic crystals. This made artificial opals a playground to test numerous optical properties of photonic crystals both linear and non linear and also to create various applications. Infiltration of opals with guest materials, a technique known as templating, is an excellent tool to provide additional functionality to bare opals to enhance their photonic properties. The most commonly used techniques involve chemical synthesis in the interior of the pores of the opals. They can be combined to produce several morphologies -conformal growth standing out for its quality- of different materials and can also be combined with physical ones where the guest material is introduced rather than synthesized in situ. The principal characteristic of PBG materials is their periodicity from which all their optical properties stem. When the order inherent to photonic crystals is eliminated a new category of photonic materials can be conceived that may, in analogy, be dubbed photonic glasses. In this new scenario, where diffusion substitutes wave propagation, new phenomena can be expected like random lasing, localization etc. Strict monodispersity and sphericity of the colloidal particles results in a resonant behaviour that shows up in the relevant light transport magnitudes like mean free path and velocity.
The special care needed to produce high quality photonic crystals is, surprisingly, also needed to produce photonic glasses because, upon sedimentation, certain colloidal particles show a strong tendency to order which has to be broken. Only conscientious attempts to fully remove order lead to structures fully devoid of any remnants of order as evidenced by optical properties or microscopy. With this material it is possible to create random lasers in which the lasing wavelength can be decoupled from gain profile and selected at will.