PROPAGATION AND SCATTERING OF LIGHT IN OPAL HETEROJUNCTIONS

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Heterogeneous three-dimensional photonic crystals with engineered light flow directionality and confinement are expected to be building blocks of upcoming functional photonic devices. To fulfil this aim they should support the ballistic regime of light propagation. The crucial question concerning these structures is the effect of the heterointerface upon the light propagation and losses.

Thin two- and three-layer hetero-opals have been prepared by subsequent crystallisation in a moving meniscus of one thin opal film on top of the other from beads of different diameters. To assess the transversal transport of the collimated light beam the angle-resolved transmission, reflectance and scattering spectra have been studied.

The major disruption of the transverse light propagation is the mismatch of the optical mode group velocities across the junction. This effect, which is most pronounced in the frequency range between two bandgaps, leads to formation of partial standing waves in heterojunction components thereby changing the heterojunction transmission.

The rapid decrease of scattered light intensity with the angle increase away from the incident beam direction in opal films is opposite to Lambert-law intensity distribution in bulk opals thus indicating the ballistic regime of light propagation. Similar angle distribution of the light intensity is preserved in hetero-opals. Comparison of different configurations of scattered light collection reveals that interface becomes the major source of light scattering. Nevertheless, in hetero-opal films the scattered light angular diagram remains narrow because interface suppresses stronger the propagation of the light at oblique angles as compared to the interface normal.

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