

## **Theoretical and experimental studies of optical properties of metal infiltrated opals**

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Synthetic opals are one of the most promising three-dimensional photonic crystal structures capable of working in the visible spectral range. Even though applicability of bare opals is limited (for instance, bare opals do not exhibit an omnidirectional bandgap), they can be used as templates to manufacture three-dimensional photonic crystals with very interesting optical and physical properties. One of the ways is to create metal infiltrated opals (MIO).

We have manufactured and studied both theoretically and experimentally opals infiltrated by various metals (Ag, Cu, In, Pb, W). In the case of a nearly perfect metal infiltrated into the opals, the photonic band structure exhibits very narrow propagating bands separated by omnidirectional band gaps. This property has been explained theoretically.

In a frequency range, when dispersion of the dielectric constant of metal,  $\epsilon(\omega)$  can not be ignored, the nearly perfect metal approximation works only qualitatively, and for rigorous calculations the specifics of the dielectric constant of the metals must be taken into account. In this case the band structure of MIO has been also calculated. In addition, the reflection, transmission and absorption coefficients of the thin film MIO have been computed. The reflection and absorption coefficients for MIO have been measured experimentally and compared with the computations. Main features of the experimental data have been explained based upon the results of the theoretical and numerical analysis.