Features of the laser induced breakdown spectrometry method in the study of ordered submicron systems based on synthetic opal matrices

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Synthetic opal matrices (SOM) are an example of three-dimensional photonic crystals, the manufacturing process of which by self-assembly is quite simple, does not require complex expensive equipment and is well-developed. On their basis, it is possible to obtain inverted opals (IO) with the necessary physical properties for various applications. The range of possible applications of such submicron ordered systems, as well as those obtained by other methods, is extremely wide—from biology and medicine to energy. The optical, electrical, acoustic and other properties of devices based on SOM and IO can be significantly influenced by the impurities contained. Thus, an effective method of monitoring the content of various impurity elements in the such structures is needed. One of such methods is the laser induced breakdown spectrometry (LIBS). The LIBS method is used for the analysis of bulk or disordered submicron materials. The purpose of this work was to study the specifics of using the method for an ordered submicron structure, using the example of a synthetic opal matrix. An increase in the intensity of the LIBS spectrum is shown when the wavelength of the exciting radiation matches the photonic band gap of opal matrices. The effect of the laser radiation wavelength on the efficiency of the method is shown. By placing metal nanoparticles on the surface of the samples, a significant increase in the intensity of the spectra was achieved.