CALCULATION OF ONE-DIMENSIONAL PHOTONIC CRYSTALS BASED ON DIAMOND

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Diamond is a very perspective material for photonic and optical applications due to its unique physical and chemical properties (e.g. high refractive index of diamond n=2.42). Despite the fact that doping with nitrogen doesn't have a strong effect on the refractive index of diamond, it nevertheless changes by ~1%, that gives us the opportunity to use a structure consisting of a set of diamond layers with and without substitutional nitrogen as a photonic crystal [1].

One-dimensional photonic crystal is a structure with periodic change of refractive indices in one direction [2]. In our work we have structure which consists of periodically alternating layers of undoped diamond and nitrogen-doped diamond layers. The main advantage of same structures is the ability to obtain almost 100% reflection in the range of the optical spectrum we are interested in. This property of one-dimensional photonic crystals makes them advantageous for use as laser resonators.

In this paper, we used the finite element method to calculate the parameters of a diamond-based one-dimensional photonic crystal of interest to us, including the values of the maximum possible reflection.

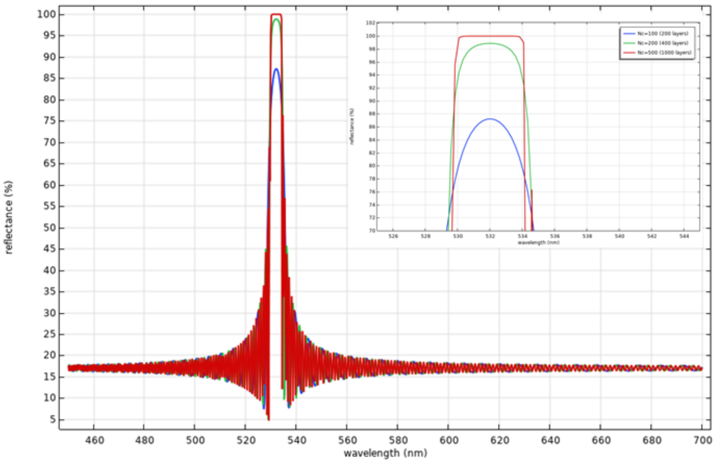

Fig. 1 Reflection from simulation

Fig. 1 shows a computed dependence graph of the reflection coefficient on the wavelength while different numbers of layers of the structure were used. The results were obtained for a different number of pairs (N=100, 200, 500) of nitrogen-doped diamond layers (n=2.39) and undoped diamond layers (n=2.42) for the wavelength of interest (λ=532 nm). When calculating the thicknesses of the layers the Wulff-Bragg's condition was used:

$$2 \cdot \Lambda = m \cdot \lambda ,$$

where Λ – period of the one-dimensional photonic crystal, λ – central wavelength, m – integer.

REFERENCES

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