THE EFFECT OF THE ELECTROMAGNETIC RADIATION WAVELENGTH ON THE NEAR-FIELD CHARACTERISTICS OF FINITE-LENGTH DIELECTRIC CYLINDERS

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I. INTRODUCTION

Numerical studies of the near and internal fields distribution (NFD and IFD) for a single dielectric cylinder of finite length are necessary in order to identify the prerequisites for electrodynamic interaction in systems of such particles. The study of the dependence of the NFD and IFD of single cylinders on the wavelength of electromagnetic radiation at constant values of the dielectric permittivity of the cylinders, their environment and dimensions was carried out [1].

II. METHOD AND RESULTS

Numerical studies were carried out for direct systems. Direct systems are understood as structures for which the refractive index of the cylinders exceeds the refractive index of the environment on the base of the volume integral equation formalism.

Figure 1 shows the distributions of the inner and near fields in the central sections of a single cylinder, which is located in the field of a plane electromagnetic wave propagating along the OZ axis, having an amplitude of

E_0 = 1 and polarized along the OY axis. Note that the mapping of the internal field distribution is obtained in the planes defined by the partition grid, which corresponds to the number of partitions used. Therefore, it is usually possible to get the NFD and IFD not in the exact geometric center of the cylinder, but only near this exact center. In this paper, a cylinder with a refractive index n = 1.73 is presented. The geometric dimensions of the particle were: d=100nm, l=1500nm. The wavelength of electromagnetic radiation is 600nm. The sections ZOX, ZOY, YOZ are considered. The value of the maximum intensity gain is k_{max}=0.86.

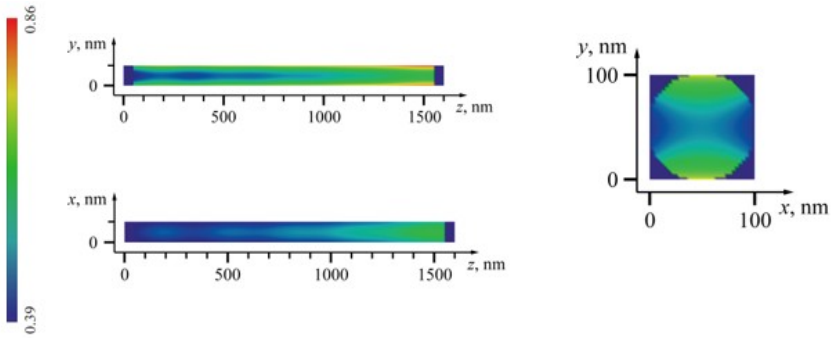

Figure 1. NFD and IFD for a single cylinder with n=1.73 and λ=600nm

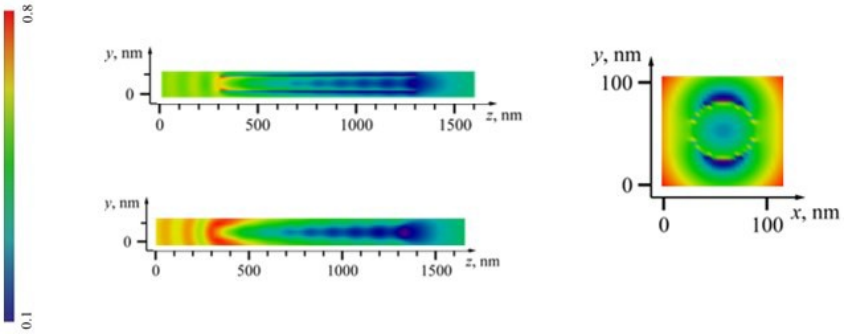

Figure 2. NFD and IFD for a single cylinder with n=1.73 and λ=400nm

Comparing Figures 1 and 2, it can be observed that, with a decrease in the wavelength of electromagnetic radiation from 600 nm to 400 nm, the NFD and IFD change. Namely, for λ = 600nm, the non-monotonic change in the intensity of the field along the entire length of the cylinder is much weaker than for λ= 400nm. There are also field intensity modulations along the length of the cylinder, attenuating along the direction of propagation of electromagnetic radiation. The modulation of the internal field in the cylinders is more pronounced, the shorter the wavelength of electromagnetic radiation. k_{max} is also reduced to 0.8.

III. CONCLUSIONS

In this paper, we conducted a comparative study of the NFD and IFD was carried out for individual dielectric cylinders with n = 1.73 with a change in the wavelength of electromagnetic radiation.

REFERENCES

[1] V.A. Kovtun-Kuszhel, R.A. Dynich, A.N. Ponyavina. Localization and scattering of electromagnetic waves in ordered arrays of finite cylinders / Problems of mathematics, physics and technics. №2(11). – pp.27 – 33, 2012.