

SCATTERING OF THE FIELD OF FAST ELECTRONS ON COUPLED NANOPARTICLES

D.I. Garaev, D.Yu. Sergeeva, A.A. Tishchenko

*National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia
 DIGaraev@mephi.ru*

2D slab photonic crystals are being actively studied not only for their interaction with electromagnetic waves, but also with charged particles. Interacting with electrons, they can produce THz radiation, with characteristics depending on the electron beam sizes. So, such targets can serve as a promising instrument for the electron beam diagnostics.

It was shown that in comparison with 1D materials there is a significant increase of radiation from 2D slab photonic crystals due to the generation of additional surface plasmon-polaritons [1]. Also, rich spectral and spatial distributions of radiation from such targets can occur due to the appearance of a band gap [2]. 2D slab photonic crystals can be organized, for example, as a massive of particles arranged in a plane [3].

Accounting for collective effects during the passage of an electron beam over such a structure is complicated problem. First, the interaction of the beam with the target leads to arising of coherent and incoherent form-factors that are difficult to calculate [4]. Second, the interaction between the particles can lead to significant effects, as was demonstrated in [5].

In this report we study the radiation, arising while the electrons interact with 2D slab photonic crystals. As a first approximation and to catch all the main effects we consider two electrons flying over two interacting nanoparticles. We show that the dipole-dipole interaction of the nanoparticles leads to a change in the orientation of their dipole moments, which significantly affects radiation patterns in the far zone. The frequency response of coupled particles to the incident field also changes: the resonant frequency shifts with respect to that for single particles.

This work was supported by the Russian Science Foundation, grant № 21-72-00113.

- [1] N. E. Glass, Enhanced Smith-Purcell radiation from a bigrating surface through multiplasmon excitation, *Phys. Rev. A*, vol. 36, pp. 5235-5250, (1987)
- [2] S. Yamaguti, J. Inoue, O. Haeberlé, K. Ohtaka, Photonic crystals versus diffraction gratings in Smith-Purcell radiation, *Phys. Rev. B*, vol. 66, p. 195202, (2002).
- [3] D. I. Garaev, D. Yu. Sergeeva, A. A. Tishchenko, Theory of Smith-Purcell radiation from a 2D array of small noninteracting particles, *Phys. Rev. B*, vol. 103, p. 075403, (2021).
- [4] A. A. Tishchenko, D. Yu. Sergeeva, Incoherent Form Factor in Diffraction and Smith-Purcell Radiations, *JETP Letters*, vol. 110, pp. 638-645, (2019).
- [5] A. A. Tishchenko, D. Yu. Sergeeva, Near-field resonances in photon emission via interaction of electrons with coupled nanoparticles, *Phys. Rev. B*, vol. 100, p. 35421, (2019).

TERAHERTZ SPECTROSCOPY OF HIGH-ENTROPY HEXAFERRITE-BASED SOLID SOLUTIONS

**A.A. Gurchenko¹, D.A. Vinnik², V.E. Zhivulin², N.A. Cherkasova², A.R. Zykova², S.A. Gudkova²,
 B.P. Gorshunov¹, L.N. Alyabyeva¹**

¹ *Moscow Institute of Physics and Technology, 141701 Dolgoprudny, Moscow Region, Russia*

² *South Ural State University, 76 Lenin prospect, Chelyabinsk, Russia*

gurchenko.aa@phystech.edu

One of the promising directions in modern material science is associated with the creation and application of high-entropy systems. During last decades, the activity was focused mainly on metallic alloys. One of the rapidly growing new fields nowadays includes investigations of possibilities of creation of high-entropy crystalline solid solutions with magnetoplumbite structure. Most popular here are M-type hexaferrites that have been known for more than half a century due to their remarkable properties — chemical inertness, mechanical hardness, high values of the Curie temperature, coercive force and anisotropy field. With such properties, these compounds are widely used in various branches of science and technology. In recent decades, interest in hexaferrites has further increased due to the possibility of their use in high-frequency electronics. It has been shown that terahertz dielectric properties of these compounds can be smoothly “tuned” by changing their chemical composition (see, e.g. [1]). Creating high-entropy phases of hexaferrites will provide even broader opportunities for effective adjustment of their electrodynamic properties over a wide range due to a smooth quantitative change in composition. Recently, we managed to synthesize and stabilize high-entropy crystalline solid solutions of such