EFFECTIVE OPTICAL DECONTAMINATION AND MANIPULATION OF VIRUSES AND BACTERIA USING META-MATERIALS

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This report proposes a method of decontamination using meta materials consisting of microspheres and fiber optics structures with various geometries. The proposed method secures a substantial gain in the decontamination contact surface during the propagation of the liquid contaminated by viruses and bacteria through the space between the microspheres (or fiber optics) of metamaterials. The efficient decontamination using the surface of the evanescent zone of meta-materials opens a new perspective not only for the applicative character of these researches, but in the fundamental investigations as well. The increasing of the surface contact of UV radiation with contaminated liquid strongly depends on the refractive index of metamaterial and liquid and optical properties of viruses and bacterias. A complementary effect of decontamination depends on the possible trapping of microparticles from liquid in the evanescent zone of fiber optics or microspheres of photon crystal structures[1-3]. In this case, during the propagation of waves through nano-fibers, a tendency of trapping and manipulating microparticles (viruses and bacteria) along the fibers becomes possible. Recent observation of the trapping of dielectric particles along the fibers opens a new perspective on the possibilities to trap the viruses, bacteria and other microorganisms from liquids. After the capture of this microorganism in the special decontamination zone the effective UV decontamination is possible.

The meta-materials, such as optical fibers or periodic photon structures open the new possibilities to manipulate and kill viruses and bacteria in contaminated zones of liquids or organic tissue[2,3]. For example, the good contact area between the implant and cells can not only be accomplished, but also guided by UV radiation along the implant surface, maintaining the good medical assistance against possible viruses or bacterias. The UV action against bacteria and viruses depends on the dimension and volume of the evanescent zone of the photonic periodical waveguide structures. In Fig. 1, we represented such a periodical structure (fibers and spherical structures) introduced into a funnel through which the contaminated fluid flows. To improve the deficient decontamination of this waveguide material, we propose a simple periodical structure of the set of planar waveguides. Periodical Fiber structures and periodical spherical materials were proposed for carrying out the required measurements in the decontamination procedures as a function of the intensity and pulse duration of UV pulses. The efficient action of UV pulse on the chemical reactions, which take place in the microorganisms is in the initial stage of our studies. Here we take into consideration the quantified structure of the energy of quasi-particle, transmitted from one DNA segment to another, or in connection of coupled protein micro-tubule. According to our investigations the cooperative effects between the atoms in the process of absorption and emission of photons lies on the photo-transformation process cellular DNA of bacterias. Development of nonlinear models of interaction of UV radiation with microorganisms opens new possibilities concedrning decontamination and diagnosis of the new collective processes

which take place in viruses, bacteria or other cellular structures under the influence of external UV pulses in the process of its propagation through the multi-cellular tissue. The possibilities of the selective actions of the UV radiation on the microorganisms with minimal effects on the human tissue are studied.

A method of decontamination of viruses using the photon-crystals consisting from microspheres and fiber optical structures with various geometries. It is demonstrated that using meta-materials like photonic crystal we have a substantial gain in the decontamination contact surface during the propagation of the liquid contaminated by viruses and bacteria through the space between the microspheres (or fiber optics) of metamaterials. The increasing of the surface contact of UV radiation with contaminated liquid strongly depends on the refractive index of metamaterial, liquid volume and optical properties of viruses and bacteria. It is studied the possibility to trap the viruses and bacterias by an effective UV decontamination method.

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