The subject of this proposal was taken from the dental practice where, in the process of root canal treatment, the secondary infection of canal often takes place. This problem, may be associated with not fully accurate realization of the treatment protocol, or can be caused by presence of bacterial strains (especially anaerobic) which are resistant to conventional disinfectants and antiseptics treatments. According to the literature data, microflora of root canals is very variable, but knowledge about influence of specific strains of bacteria and other pathogens (fungi or protozoa) on the appearance of inflammation of apical tissues is poorly understood.

The representative group of patients will participate in these studies, which will allow us to determine the qualitative and quantitative composition of microflora in root canals of teeth. Systematization of the data will enable statistical study of the results, that will give the ability to identify the most common pathogens in the root canals of people with a specific diagnosis. It will allow to generate a database containing detailed information about the frequency of occurrence of specific pathogens and their association with variable data, such as: the patient's age, sex, general health condition (incidence of diseases, their association with infection in mouth), dental health (presence of caries lesions, other pathological conditions). Moreover, bacterial strains characterized by a resistance to conventional disinfectants will be recognized. These strains will be further used to test the antimicrobial properties of newly developed bactericidal materials.

According to aforementioned problem, we propose new material that is efficient, active also against resistant bacteria strains, and based on graphite oxide (GO), photosensitizer (e.g. derivative of metal phthalocyanine), and silver nanoparticles. The selected composite materials implement the idea of creating an antimicrobial agent that is stable (not decomposable in tissues) and have long-lasting activity increased non-invasively under light irradiation. The newly obtained and preliminarily characterized photosensitive composite materials are very interesting and worth to be further studied for their physicochemical and antimicrobial properties. The realization of this task is associated with several studies of each components and the whole composite, because each element, when it is included to composite system, should fulfill its function without disturbing the action of other ingredients, and as a whole material, it should have enhanced effect, better than previously observed for analogues or traditional antiseptic agents (eq. antibiotics). The (photo)activity of the material should be maintained, or even improved, after locating it in an inorganic matrix, such as $TiO_2$ or ZnO (i.e. components of cements used for root canals filling).

Due to the specific composition of the composite materials, different synthesis procedures will be used, including the current methods for sonochemistry (using high power ultrasound), directed to obtain a stable system. Next, we plan to realize series of investigations, which allow to specify the composition, structure, morphology, and physicochemical properties, mainly photochemical, i.e. generation of reactive oxygen species (singlet oxygen and free radicals) under light irradiation.

The most important task will include determination of the antibacterial activity, that should be changed under the influence of light (especially in the near infrared range), because we expect the activation of system during irradiation through emerging reactive oxygen species but also due to possible thermal effect. Bacteria strains, chosen after clinical tests, will be used in microbiological test with developed new nanocomposites. Special attention will be allocated to examine the mechanisms of composites' influence on different bacteria strains (e.g. anaerobic and aerobic) and the mechanisms of development of bacterial resistance against these group of materials. Also pre-clinical tests on the cytotoxicity and genotoxicity on eukaryotic cells will be carried out (*in vitro* with cell cultures and *in vivo* with butterfly larvae *Galeria mellonela*).

Proposed materials could be used as antimicrobial agents in conservative dentistry and endodoncy, but also in other fields of medicine and not only (e.g. development of dressing materials for the treatment of hard to heal wounds and decubitus ulcer, for production and/or covering of implants with biocompatible and/or bioactive film, production of filtration materials, including filters, used for protecting of the sterility of the air in the medical institutions or pharmaceutical factories, development of photocatalytic materials).