The aim of the proposed research is to fabricate new glasses, in the form of nano-powders and composites with graphite oxide, which will have biological activity, that is which will be enable to form a permanent connection between the glass and the tissue. It is believed that the appropriate modification of the known material (called bioglass and consisted of silica, calcia, and phosphorus oxide) with active agents (eg. metals, vitamins, luminescent compounds, appropriate functional groups) will improve (or gain) their bioactivity. We also expect to obtain multifunctional material, i.e. fulfilling several functions simultaneously. For example, a material to prevent inflammation after surgery and to enhance the process of 'adoption' of a foreign body by the patient.
These materials will be obtained by the sol–gel process that allows to obtain glass materials from the solution in the form of powders. Glass powders and flakes of graphite oxide will be used to fabricate nanocomposites which should have better biological properties than the pure glass or corresponding microcomposites.

In order to determine the properties of the prepared materials, verify assumptions and select material with the best bioactivity, research must be done using methods allowing for measurements in nano and submicron scale (among others, the electron microscope, gas sorption, profilometer, and spectrophotometer will be used). Parameters such as: chemical composition, crystalline structure, porosity, specific surface area, particle size, degree of aggregation will be defined.

Biological studies will be carried out in two stages. In the first step, the potential for growth of hydroxyapatite (an inorganic component of bones and teeth) on the obtained materials in the presence of simulated body fluids (SBF) will be examined. The second stage of the research will be performed in a biological laboratory, where cell culture (in vitro studies with, for example, stem cells derived from adipose tissue) will be used, and in a microbiology laboratory, where tests with selected bacteria strains will be done. The implementation of these studies will help to determine the impact of glasses and composites on the behavior of biological materials. The following parameters will be determined: the capacity and speed of formation of apatite layer; viability, the proliferation rate and the possibility of stem cell differentiation; and also antibacterial properties.

Among the expected innovative results of the project can be mentioned:
• Development or simplifying the procedure for obtaining multi-component glasses and composites;
• Fabrication of materials with higher biological activity, promoting the growth and adhesion of osteoblasts and stem cells;
• Fabrication of multifunctional powders and composites, eg. with additional antimicrobial or luminescent properties.

The research may contribute to a development of novel biomaterials with enhanced bioactivity and multifunctionality that will find application in dentistry and implantology, for example, to accelerate the regeneration of bone tissue.

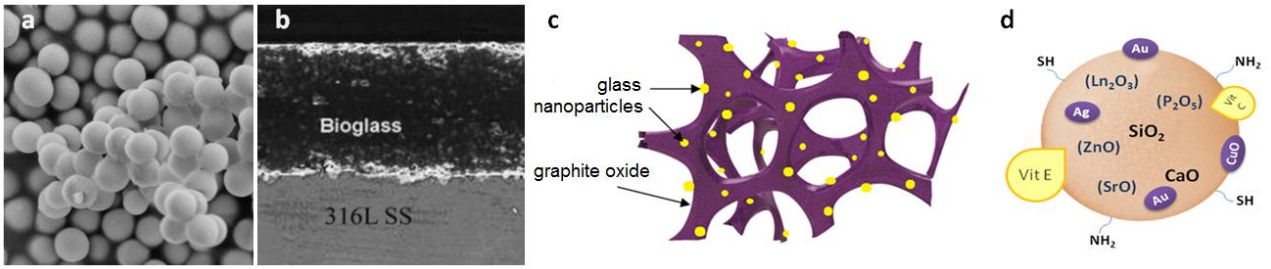

Figure. SEM images of (a) nanoparticles of bioactive glass (ø 100 nm) and (b) glass layer on the implant substrate [M.H. Fathi and A. Doostmohammadi, J. Mater. Proc. Technol. 209, 2009, 1385]. (c) A schematic drawing of the composite – graphite oxide foam with glass nanoparticles. (d) Possible modifications of the glass composition.