Photo- and Bioactive Nanoglasses

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A well-known in medicine bioactive glasses, that are used for tissues regeneration, are mainly based on silica–calcia system (although other promising compositions are currently under study). Glass nanostructures might show higher activity and broader range of applications in comparison to their commonly used microsized counterparts. Moreover, additional components or functionalization may ensure photoactivity and expand further their utilization. Hereby, we present studies on nanoparticles of bioactive glasses showing photoluminescence. Instead of melt-quenching, other methods of wet chemistry, such as the sol–gel technique, are used for particles fabrication. The crystalline structure, composition, morphology, and porosity of the samples are strongly dependent on the synthesis conditions. To ensure photoactivity, the glass composition is modified by the addition of lanthanide ions or phthalocyanine complexes with metals. Glasses are active in different spectral ranges of the electromagnetic spectrum depending on the activators. For example, the introduction of europium ions allowed to obtain optically active materials exhibiting red luminescence. Co-doping with Tm^{3+} and Yb^{3+} resulted in green light emission due to the up-conversion energy transfer among active ions when excited by 980 nm. Systems with phthalocyanine complexes showed broadband emission in the red–near-infrared region. The photoactivity is observed not only as luminescence, but also as singlet oxygen generation or photocatalytic degradation of organic dyes. The biotransformation tests indicates that when particles are immersed in the simulated body fluid, ions are released into the medium, and hydroxyapatite layer forms on the glass surface. Lack of cytotoxicity and induced cell proliferation are often characteristic for the presented glasses thus, bioapplications can be successfully studied. Drug delivery, bioimaging, contrast agent for magnetic resonance imaging, tracking of glass transformation, or photodynamic therapy are the examples of the researchers' interest.