Application of Sonochemistry for Formation of Nanosized Silver and Silver/Hydroxyapatite Composite Particles

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Development of nanotechnology during last few decades gave significant contribution to different areas of research especially in biomedical sciences and improved characteristics of many biomaterials allowing their commercial application [1,2]. One of the representative examples is the development of nanomedicine, a new field of medical research which opened the possibility for interactions between nanomaterials and pathogens at the same scale of size [3]. This approach allowed development of nano-therapeutics, biosensors and point-of-care molecular diagnostic devices resulting in target, localized and more efficient medication [4]. So far, different techniques are applied for formation of these materials. Among them, sonochemical synthesis can be separated as a method based on the high temperature and pressure combined with intensive mixing induced by acoustic cavitation and micro jets. This method enables control over size, morphology and nano-/micro-structure of materials that are often unavailable by conventional methods [5].

The main goal of our work is application of the sonochemical synthesis method for preparation of nanosized particles of silver and silver composite with hydroxyapatite, as well-known bioactive and osteoconductive bioceramics for potential application in biomedicine as bone-defects filler with preventive anti-inflammatory properties. Urea, known as a homogeneous precipitation agent, was applied as capping agent of silver which allowed formation of silver complex able to be decomposed at 300°C and to form nanosized silver particles up to 20 nm in size. In the case of co-precipitation of silver with hydroxyapatite particles, after thermal decomposition of silver complex, hydroxyapatite/silver composite was obtained. At such conditions, uniform distribution of nanosized silver particles, with the size up to 10 nm, located onto the surface of hydroxyapatite submicrometre-sized rod-like particles, was obtained. These changes of the morphological properties of nano-silver, and its distribution, suggested a possible influence of hydroxyapatite surface on the mechanism of silver particles' growth. From the side of applicability, importance of obtained HAp/Ag composite morphology can be addressed to the well-known size-related dependence of antibacterial activity of metallic silver particles which showed significant improvement of this property of silver particle with the size in the range between 1 and 10 nm. This can be correlated to its possible application in orthopedics and dentistry.

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