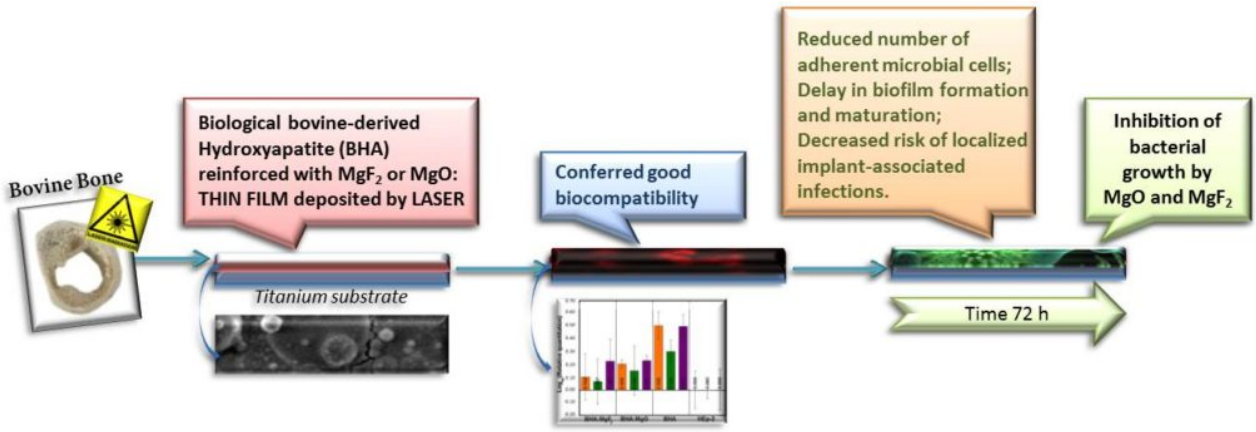
Materials for tomorrow: right next to us!

The idea of an artificial device able to help human parts to regenerate or to replace entirely one of the body functions attracted the attention of research teams around the world. During recent years, a route of science is strictly related to the need of finding renewable materials that are not only compatible to the environment but also are friendly with human health and lifestyle. Nowadays, it is considered that laser-based technologies are among the main, most powerful tools for fabrication of thin coatings of a wide range of different materials/biomaterials with controlled parameters. Novel biological bovine-derived hydroxyapatite (BHA) reinforced with MgF_2 or MgO were transfer by laser in order to obtained thin coatings on pure titanium (Ti) supports.

The aim of this research was to obtain coatings with improved adherence, biocompatibility and antimicrobial activity and to use them as a new generation of dental, orthopedic and cardiological metallic implants with increased functionality.



Why bovine bones? An important aspect is that HA of animal origin contains oligoelements which are also present in the human bone, and are important for its functionality. More than this, one expects that BHA will be a renewable material for an indefinite number of years.

Putting all the physico-chemical analyses in the same frame, we found that those structures prove to be beneficial and confer a “friendly”-like medium to cells, able to grow healthy and harmonious on the surface of the coatings. Moreover, the results of *in vitro* HEp-2 cells cultures revealed that the surface modification of metallic implants with simple or reinforced BHA coatings conferred good biocompatibility. We have demonstrated that the addition of MgF_2 and MgO to BHA does not only improve the adherence (bonding strength values of ~49 MPa and ~56 MPa recorded for BHA:MgO and BHA:MgF_2, compared to minimum mandatory values (15 MPa) imposed by the International Standard Regulating (13,779–2/2008)) or biocompatibility of the structures. It also maintains, and in many cases increases the anti-biofilms properties of coatings.

Functional coatings for advance implants

Biofilms are the most common mode of bacterial growth and lead to clinical infections (up to 80 %), especially because of their high antibiotic resistance. That is why there exists a stringent need for new and efficient implant functionalization solutions. Biofilms on indwelling medical devices result in significant morbidity and mortality and have a substantial impact on healthcare systems worldwide. Biomaterial-associated infection incidence is increasing proportionally to the number of people gaining access to medical device technologies wide-reaching, but also due to the emerging microbial resistance to current antibiotics. The clinical experience showed that Ti devices are frequently colonized by microbial strains and the biofilm formation represents a huge complication in implant surgery.

After the microbial adhesion and biofilm development tests on our coatings, two hypotheses could account for the decrease of the number of biofilm embedded cells: *a.* the surface coatings prevent the microbial/bacteria adhesion, and *b*. the coatings exhibit a microbicidal activity, killing the cells before or after the contact with the coated surfaces. The second hypothesis is supported by the results of the minimal inhibitory concentration assay showing an increased microbicidal activity of BHA:MgO and BHA:MgF_2 versus simple BHA against *Micrococcus sp., Enterobacter sp. and Candida albicans sp.,* isolated from patients with dental implants failure.

Transferred by laser technologies in form of thin coatings, reinforce bovine bones are a good alternative to synthetic Hydroxyapatite for the fabrication of reliable implant coatings for dentistry, orthopedy and cardiology.

One may assume that the link between laser and bovine bones could lead to new alternatives to improve the health for tomorrow.

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Publication

Structural, compositional, mechanical characterization and biological assessment of bovine-derived hydroxyapatite coatings reinforced with MgF2 or MgO for implants functionalization.
Mihailescu N, Stan GE, Duta L, Chifiriuc MC, Bleotu C, Sopronyi M, Luculescu C, Oktar FN, Mihailescu IN
Mater Sci Eng C Mater Biol Appl. 2016 Feb 1