Trends and opportunities of metastable metallic dental and related materials

We are pleased and honored to have the opportunity of editing this special issue of the Journal of Metallurgy, dedicated to challenges regarding metastable metallic dental and related materials, their processing, and applications. We should perhaps begin by thanking all those authors who contributed their work, together with professor Karlo Raić and his management board at the Journal for making this issue possible.

We doubt if there is anyone active in the different fields of science today for which the interdisciplinary of the research work is unfamiliar. One of the most comprehensive, and currently very intensively, targeted subjects where researchers from two or more disciplines work together, pool their approaches and modify them, is the field of dental materials. The functions required of dental materials and devices are extremely varied and they must be performed within the environment of the human body – an environment that is surprisingly hostile and aggressive, yet one that is extremely sensitive. All these necessities demand very close cooperation among researchers from different disciplines.

Few phenomena, over the last few decades, have engaged the curiosity of materials scientists as much as the behavior referred to as "the metastable states of engineering materials". Rapidly solidified materials, amorphous metals and alloys, nanostructures, and thin layers or interfaces, are some examples which already indicate great potential. In the future, in many areas of dentistry, these materials will constitute those critical elements on which the will depend feasibility and performances of devices and the abilities of processes. Today's limits in the numerous fields of medical application can only be overcome by new and improved materials which, in most cases, are produced by transforming the structures of known materials into various thermodynamically-metastable microstructures and states. Depending on the influential external parameters, specific chemical reactions that cannot be predicted or anticipated from known equilibrium transformations, take place in such thermodynamically-metastable systems and, consequently, new phases and microstructures, which cannot be found in the equilibrium phase diagram, come into existence. While the properties of materials are mainly dependent on the microstructure, it is possible by inducing the metastable states, to attain special new properties for engineering materials.

It was our aspiration to collect in this issue, those papers which are multidisciplinary and directed towards different problems of metallic and other advanced dental materials. Thus, they are closely linked to ongoing research in the fields of production technologies, microstructural characterization, determining the properties of materials' surface layers in the human body and studying microstructural changes in metal-ceramic interfaces. We believe that the papers presented in this issue confirm the significance and necessity of linked research work and will additionally stimulate cooperation between researchers from material science and medical disciplines.

Professor Ivan Anžel, PhD
Professor Dragoslav Stamenković, PhD