Editorial

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The first-generation conventional materials applied in dental and orthopedic applications have been selected based on their adequate mechanical properties and capability of remaining inert in vivo. This selection process has its own limitations resulting in implant failure and in many cases cannot fulfill the other requirement for a life-lasting durable implant inside the body. Therefore, due to the lack of appropriate physical, chemical and architectural properties of traditional dental and orthopedic implants, the success rate of implantation are not satisfactory enough.

The poor surface properties of conventional materials have resulted in clinical complications such as insufficient bonding and integration to bone tissue, as well as corrosion and tribocorrosion of the implant, resulting in the release of metal ions and consequent chronic inflammation and infection. Under such circumstances revision surgery is required for removal or replacement of the failed implant. Insufficient osseointegration between implant interface and bone as well as implant/tissue modulus mismatch may lead to stress and strain imbalances affecting bone remodeling and tissue regeneration that can cause implant loosening and/or failure. Considering such shortcomings of conventional and first-generation implants, there is a pressing need for implants with advanced and multifunctional properties that can overcome such limitations, with prolonged life span and minimal to no rates of failure.

The current special issue is dedicated to advanced materials in dental and orthopedic applications. The first paper investigates immobilization of apatite on Ti30Ta alloy surface by electrospinning of poly(ϵ -caprolactone)¹. Results of this paper indicate that the surface treatment of the Ti30Ta alloy with electrospun fibers and apatite immobilization may increase the bioactivity of the surface and provide a beneficial surface modification for use in biomedical applications.

The second paper is a research article on flexible hydroxyapatite fiber (HAF) with high crystallinity precipitated by urea through a hydrothermal route.² Analysis using field emission scanning electron microscopy, Fourier transform infrared spectrometry and X-ray diffraction established a comprehensive composition and morphological characterization of the products. This study demonstrates a facile hydrothermal synthesis of HAF without adding any structure-directing agents and templates.

This is followed by a research article on the effect of different voltages and times on the electrochemical anodization of a Ti–15Zr implant.³ This study demonstrates that the anodization parameters can control the nanotubular morphology of commercially available

Ti–15Zr dental implants, which can be a promising solution for enhancing cell adhesion and osteogenesis behavior.

The fourth paper is an evaluation of the mechanical and electrochemical properties of fluoridated hydroxyapatite (FHA)-coated cobalt–chromium (Co–Cr) implants.⁴ This study indicates that the FHA coating has a denser structure compared to the hydroxyapatite-coated layer, resulting in the improvement of mechanical properties as well as corrosion resistance. Furthermore, immersion test findings reveal that the FHA-coated Co–Cr implant shows lower Cr ion release after 1, 7, 14 and 21 d of immersion as compared to the hydroxyapatite-coated implant.

The next paper is a study on the effect of electroless nickel plating on the properties of cold-sprayed nickel–alumina (Ni–Al₂O₃) coatings,⁵ which showed that the corrosion resistance of the nickel plating/nickel–alumina coating system significantly improved and no corrosion effects and crack generation were observed at the substrate–coating interface.

Finally, the last paper is on the electrochemical characteristics of ultrananocrystalline diamond (UNCD) coatings for dental implant applications.⁶ The main objective of this work was to investigate the basic electrochemical behavior of UNCD-coated samples of commercially pure titanium (Cp-Ti/Ti-2) and titanium alloy (Ti–6Al–4V/Ti-5), and compare it with the behavior of the uncoated control samples at three different pH conditions of artificial saliva. Potentiodynamic and impedance measurements also showed improvement in the electrochemical behavior of both UNCD-coated titanium samples for all three pH conditions. These preliminary findings indicate that UNCD coatings could be considered for the next generation of the dental implants in order to improve their performance.

In conclusion of this special topic, advanced materials for dental and orthopedic applications are needed as next generation implants, enabling biocompatible surface properties for promoting osseointegration as well as mechanical and biological properties similar to those of physiological bone for biomimetic and regenerative characteristics.

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