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Editorial

Special Issue on "Active Materials for Medical Applications"

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This Special Issue was proposed by engineers, physicists, medical doctors, researchers and scientists. We intend to analyze and discuss different topics on active materials for medical applications. There is great potential in the application of active or smart materials (metallic, polymer or ceramic) for the progression of applications in the medical domain of MEMS, actuators, sensors or functional systems. Active or "smart" materials have the ability to respond to different physical or chemical stimuli in a specific, repeatable mode. The actual activity in the domain, however, presents problems connected to obtaining and processing, characterizing, modeling and simulating or prototyping technologies. This Special Issue of *Applied Sciences* focuses on the most recent advances in obtaining and thermal and mechanical processing active materials used in the medical field with enhanced performances.

In this volume, two papers deal with biodegradable metallic materials based on Mg and Zn (Microstructural, Electrochemical and In Vitro Analysis of $Mg_{0.5}Ca_xGd$ Biodegradable Alloys [1] and In Vitro Corrosion Behavior of $Zn_3Mg_{0.7}Y$ Biodegradable Alloy in Simulated Body Fluid (SBF) [2]), presenting findings in this new important field with new chemical systems, degradation rate determination and main physical, chemical and mechanical properties.

Biodegradable metallic materials represent a new class of biocompatible materials for medical applications based on numerous advantages. Among them, those based on zinc have a rate of degradation close to the healing period required by many clinical problems, which makes them more suitable than those based on magnesium or iron. The poor mechanical properties of Zn can be significantly improved by the addition of Mg and Y. In this research study, we analyze the electro-chemical and mechanical behavior of a new alloy based on $Zn_3Mg_{0.7}Y$ compared with pure Zn and Zn_3Mg materials [2].

Microstructure and chemical compositions were investigated by electron microscopy and energy dispersive spectroscopy. Electrochemical corrosion was analyzed by linear polarization (LP), cyclic polarization (CP) and electrochemical impedance spectroscopy (EIS). For hardness and scratch resistance, a microhardness tester and a scratch module were used. Findings revealed that the mechanical properties of Zn improved with the addition of Mg and Y. Zn, Zn-Mg and Zn-Mg-Y alloys in this study showed highly active behaviors in SBF with uniform corrosion [2]. Zinc metals and their alloys with magnesium and yttrium showed a moderate degradation rate and can be considered as promising biodegradable materials for orthopedic application.

Two other papers are based on the Finite element method (FEM) of investigation with exceptional findings in the field of mandibular anterior teeth with healthy but reduced periodontium and inlay-retained dental bridges [3,4].

Finite element analysis studies have been of interest in the field of orthodontics, and this is due to the ability to study stress in the bone, periodontal ligament (PDL), teeth and the displacement in the bone by using this method. Our study aimed to present a method that determines the effect of applying orthodontic forces in a bodily direction on a healthy

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and reduced periodontium and to demonstrate the utility of finite element analysis. Using the cone-beam computed tomography (CBCT) of a patient with a healthy and reduced periodontium, we modeled the geometric construction of the contour of elements necessary for the study [4].

Afterwards, we applied a force of 1 N and a force of 0.8 N in order to achieve bodily movements and to analyze the stress in the bone, in the periodontal ligament and in absolute displacement. The analysis of the applied forces showed that a minimal ligament thickness is correlated with the highest value of the maximum stress in the PDL and decreased displacement [4]. This confirms the results obtained in previous clinical practice, confirming the validity of the simulation. During orthodontic tooth movements, the morphology of the teeth and of the periodontium should be taken into account. The effect of orthodontic forces on a particular anatomy can be studied using FEA, a method that provides real data. This is necessary for proper treatment planning and its particularization depends on the patient's particular situation [4].

Other interesting topics of the special materials used in medical field cover the following: Surface Analysis of 3D (SLM) Co–Cr–W Dental Metallic Materials [5], Laser Induced Method to Produce Curcuminoid-Silanol Thin Films for Transdermal Patches Using Irradiation of Turmeric Target [6], Corrosion-Resistance Analysis of HA Layer Deposited through Electrophoresis on Ti4Al4Zr Metallic Substrate [7], Magnetic Abrasive Finishing of Beta-Titanium Wire Using Multiple Transfer Movement Method [8], Effect of Alkyl Structure (Straight Chain/Branched Chain/Unsaturation) of C18 Fatty Acid Sodium Soap on Skin Barrier Function [9] or Self-Expandable Retainer for Endoscopic Visualization in the External Auditory Canal: Proof of Concept in Human Cadavers [10].

A new possible method to produce a transdermal patch is proposed [6]. The study refers to the pulsed laser deposition method (PLD) applied on turmeric target in order to obtain thin layers. Under high-power laser irradiation of 532 nm wavelength, thin films containing curcuminoids were obtained on different substrates such as glass and quartz (laboratory investigation) and hemp fabric (practical application). Compared with FTIR, SEM-EDS and LIF analyses proved that the obtained thin-film chemical composition mainly comprises demethoxy curcumin and bisdemethoxycurcumin, which is evidence that most of the curcumin from turmeric has been demethixylated during laser ablation. Silanol groups with known roles in dermal reconstruction are evidenced in both turmeric target and curcuminoid thin films. UV–VIS reflection spectra show the same characteristics for all curcuminoid thin films, indicating that the method is reproducible [6].

The method proves to be successful for producing a composite material, namely curcuminoid transdermal patch with silanol groups, using directly turmeric as target in the thin film deposited by pulsed laser techniques. Double-layered patch curcuminoid–silver was produced under this study, proving compatibility between the two deposited layers. The silver layer added on the curcuminoid-silanol layer aimed to increase antiseptic properties relative to the transdermal patch [6].

Titanium is often used in various important applications in transportation and the healthcare industry. The goal of this study was to determine the optimum processing of magnetic abrasives in beta-titanium wire, which is often used in frames for eyeglasses because of its excellent elasticity among titanium alloys [8].

To check the performance of the magnetic abrasive finishing process, the surface roughness (Ra) was measured when the specimen was machined at various rotational speeds (700, 1500 and 2000 rpm) in the presence of diamond pastes of various particle sizes (0.5, 1 and 3 μm). We concluded that the surface roughness (Ra) was the best at 2000 rpm, 1 μm particle size and 300 s processing time, and the surface roughness of β-titanium improved from 0.32 to 0.05 μm. In addition, optimal conditions were used to test the influence of the finishing gap, and it was found that the processing power was superior at a gap of 3 mm than at 5 mm when processing was conducted for 300 s [8]. A study was conducted to investigate the efficacy of a self-expandable retainer (SER) for the endoscopic visualization of the external auditory canal (EAC). Tympanomeatal flap

(TMF) elevation was performed in six cadaveric heads. Two different types of SER were placed. Procedural feasibility was assessed by using endoscopic images. Technical success rate, procedure time, endoscopy lens cleaning, and the presence of mucosal injuries were analyzed. TMF elevation and SER placement were successful in all specimens, and there were no procedure-related complications.

The mean procedure time with the SERs was significantly shorter than without ($p < 0.001$). The mean number of times at which the endoscopy lens was cleaned during the procedure was significantly lower in the SER group ($p < 0.001$). In the SER group, endoscopy insertion into the EAC was easier without tissue contact with the lens during the TMF elevation compared with the non-SER group. There were no mucosal injuries. SER placement is effective for endoscopic visualization via the expanded and straightened EAC. A fully covered type of SER is preferable. The device can be useful for endoscopic ear surgery, reducing procedure time and reducing the need for endoscopy lens cleaning during the procedure [8].

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