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Investigation on the effects of FSW process on the butt joints of Al-12%Si/10wt%TiC In-situ composites

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In fusion as well as solid state welding of materials, the joining process takes place due to the combined effect of temperature, pressure and metallurgical conditions. Consequently, certain metallurgical and mechanical property changes are expected in the weld joint. The purpose of the current study is to investigate the microstructural evolution and mechanical property changes on the butt weld joint of friction stir welded Al+12Si/10wt%TiC *in-situ* composite plates at hot rolled condition. Axial load, tool geometry, tool rotational speed and traverse speed was considered as input parameters and ultimate tensile strength, percentage elongation and micro-hardness as output measures. The tensile fracture mechanism of the experimental composites also assessed. The results revealed that Al+12Si/10wt%TiC *in-situ* composite plates were successfully joined by FSW process with a joint efficiency of 85%. The percentage elongation enhanced by 14.3% whereas the UTS reduced by 15%. The fractured surface of the tensile specimen exhibited a purely brittle fracture mechanism without dimple formation in both base composite as well as FSW butt joint.

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Chitosan/HA composite scaffolds for controlled drug delivery

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Trabecular bone is severely affected by osteoporosis, therefore porous scaffolds identical to trabecular bone in porosity, density, and biomechanical properties are an area of intense research. In an effort, hydroxypropyl methyl cellulose (HPMC) mediated synthesis of scaffolds containing hydroxyapatite (HA) and chitosan (CS) as major inorganic and organic phases; a mixture of HA, CS, and HPMC was homogenized and freeze dried to yield highly porous composite scaffolds. Five different compositions having different concentration of HPMC were synthesized. These scaffolds were characterized by Fourier transform infrared (FTIR) spectroscopy, x-ray diffraction (XRD), differential scanning calorimetry-thermogravimetry (DSC-TG), Universal testing machine (UTM) and scanning electron microscopy (SEM). The in vitro biodegradation of the composite scaffolds in the PBS solution with different incubation times was also investigated. The biocompatibility testing was performed through cell culturing techniques. Also, in order to prevent the increasing frequency of per-operative infections, such a well-developed porous structure facilitated usage in a drug delivery system due to its high surface area and blood circulation efficiency. Therefore, the scaffolds were loaded with antibiotic (ibuprofen), and the release profile was checked. Scaffolds with different HPMC concentrations were elaborated with specific internal porosities for using as antibiotic carrier materials. UV spectrophotometry and bacteria inhibition tests (against S. aureus and E. coli) were performed for testing the antibiotic adsorption and the microbiological effectiveness after loading with Ibuprofen. The micro-porosity of scaffolds with different HPMC concentrations had different release times of antibiotics under mimic physiological conditions. Moreover, the PCL polymer, as a coating component, was used to effectively entrap the drug. PCL was coated prior to drug loading, as well as "simultaneous drug loading and PCL coating" experiment was performed to compare the release profile in both of the cases. The results suggested the possibility of a controlled drug release in the porous scaffold with PCL coating.

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