Mechanical properties of Ti-C composite and its biomedical applications

Anna Martinez[a,d] ,Saul Sandoval[a,e], Sandra Rodríguez[a,b], Carolina Rojas[a,c] Javier Avalos[a,f], Darinel Ortiz[e], Gerardo Morell[a,b], and Brad R. Weiner[a,c]

[a] Molecular Sciences Research Center, University of Puerto Rico, San Juan, PR 00926, USA
[b] Department of Physics, College of Natural Sciences, University of Puerto Rico, Rio Piedras Campus, San Juan, PR 00925-2537, USA
[c] Department of Chemistry, College of Natural Sciences, University of Puerto Rico, Rio Piedras Campus, San Juan, PR 00925-2537, USA
[d] Department of Biology, University of Puerto Rico, Rio Piedras Campus, Bayamon, PR 00925-2537, USA
[e] Department of Biology, University of Puerto Rico, Bayamon Campus, Bayamon, PR 00959-1919, USA
[f] Department of Physics, University of Puerto Rico, Bayamon Campus, San Juan, PR 00959-1919, USA

Many types of orthopedic implants are made of titanium alloys. Among all alloys, Ti6Al4V (90% titanium, 6% aluminum and 4% vanadium) is the most popular due to its strength and better corrosion and fatigue resistance. However, the Young's modulus of Ti6Al4V is still about 5 to 6 time greater than human bone, causing stress shielding, which leads to a weakening and loss of density of the surrounding bone. It is possible to change the rigidity of the implant to make it more suitable for the bone by using a porous variation of the titanium alloy. However, other mechanical properties are compromised by the porosity. In this study, carbon-based nanomaterials were grown on Ti6Al4V with the purpose of tailoring the mechanical properties, while increasing the biocompatibility and osseointegration capability of the Ti-C composite. Chemical Vapor Deposition (CVD) was used to deposit carbon nanomaterials on Ti6Al4V pellets, which were previously fabricated by the space holder method. The biocompatibility of Ti-C composite is analyzed using osteoblast cells.