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射频磁控溅射制备 **HA(+ZrO_2+Y_2O_3)/Ti6Al4V** 复合生物活性涂层

赵玉涛, 程晓农, 戴起勋, 林东洋, 李素敏

江苏大学材料科学与工程学院, 镇江 212013

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摘要 采用射频磁控溅射法制备了HA(+ZrO_2+Y_2O_3)/Ti6Al4V 生物复合涂层. 借助于XRD、SEM、FTIR和AFM等对溅射涂层的相组成、微观形貌和界面结合进行了研究, 并以模拟体液试验探讨了涂层的生物活性. 实验结果表明: 磁控溅射的复合涂层呈非晶态, 经过退火处理, 可以使其转化为晶态; 复合涂层的微观表面凹凸不平, 并呈现网状结构和较多的孔隙, 其孔隙直径约为0.5～2.0μm, 孔隙面积占涂层表面积的30%～40%; HA(+ZrO_2+Y_2O_3)/Ti6Al4V 复合涂层的界面结合强度随(ZrO_2+Y_2O_3)复合颗粒含量的增大和溅射功率的提高而增强, 最高可达59.6MPa. 复合涂层在模拟体液中浸泡一段时间后, 表面覆盖一层新生物质---含有CO_3^{2-}的类骨磷灰石, 其晶粒非常小, 它与自然骨中无机相的结构成分相似, 表明复合涂层具有良好的生物活性.

关键词 HA(+ZrO2+Y2O3)复合涂层 射频磁控溅射 结合强度 生物活性

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HA(+ZrO_2+Y_2O_3)/Ti6Al4V Bioactive Composite Coating Fabricated by RF Magnetron Sputtering

ZHAO Yu-Tao, CHENG Xiao-Nong, DAI Qi-Xun, LIN Dong-Yang, LI Su-Min

School of Materials Science and Engineering, Jiangsu University, Zhenjiang 212013, China

Abstract HA(+ZrO_2+Y_2O_3)/Ti6Al4V composite coatings were fabricated successfully by radio-frequency magnetron sputtering RF-MS technique. The surface and interface morphologies, phase composition and chemical structure of the composite coatings were characterized by scanning electron microscope (SEM), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR). Experimental results show that the amorphous coating deposited by RF-MS can be transferred into that with crystalline structure and restored OH- group by post-annealing. The surface morphology of composite coatings is coarse and uneven with the well-distributed concaves. The average diameter of these concaves is in the range of 0.5～2.0μm, and the surface area of these concaves is about 30%～40%. These concaves will greatly increase the micro-surface area of coating. Interfacial tensile test indicates that the interfacial bond strength between HA(+ZrO_2+Y_2O_3)/Ti6Al4V composite coating and substrate is 59.6MPa. Furthermore, the bond strength of HA(+ZrO_2+Y_2O_3)/Ti6Al4V composite coatings is enhanced with the increasing of sputtering power. Results of simulated body fluid (SBF) test indicate that a new substance on the surface of HA (+ZrO_2+Y_2O_3)composite coating will be produced after the composite coating immersed in simulated body fluid (SBF), this substance is bone-like apatite containing CO_3^{2-} group and has very small grain size and amorphous structure, its structure and composition are similar to those of natural bone. Thus, HA(+ZrO_2+Y_2O_3)/Ti6Al4V composite coatings have good biocompatibility and bioactivity.

Key words HA(+ZrO2+Y2O3)/Ti6Al4V composite coatings radio-frequency magnetron sputtering bond strength bioactivity

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通讯作者 赵玉涛 zhaoyt@ujs.edu.cn