行政院原子能委員會
委託研究計畫研究報告

電漿合成類鑽碳膜技術應用於國產人工關節表面改質之耐磨機制研究

The wear resistance of artificial joint coated with diamond-like carbon films (DLC) deposited by plasma immersion ion implantation

計畫編號：952001INER016
受委託機關(構)：國立陽明大學
計畫主持人：蔡瑞瑩
核研所參與人員：蔡文發, 艾啟峰
聯絡電話：02-28267024
E-mail address：Ruey@bme.ym.edu.tw
報告日期：95.12.25

中文摘要

人工關節用超高分子量聚乙烯元件與對磨金屬之磨耗造成之磨屑問題，為造成置換手術失敗之主要原因。諸多文獻指出，類鑽碳磨披覆於金屬表面，可有效提高材料表面硬度，並改善摩耗問題。本研究以電漿離子浸沒注入沈積技術(PⅢ-D)探討改變沈積時間、負偏壓及不同中界層對表面鍍膜性質之影響。研究結果顯示，鍍膜速率隨負偏壓增加而下降，此可能係受離子所攜帶之能量大小影響。拉曼光譜分析之結果顯示當負偏壓由 0.5 增至 2KV 時，傾向石墨化結構之生成。經鍍膜後，可改善材料之表面硬度，唯其表面彈性模數值則下降。提高負偏壓值，表面硬度及表面彈性模數值均相應上升。摩擦測試結果顯示類鑽碳膜鍍膜造成乾摩擦係數值顯著之下降及濕摩擦係數值之上升。鍍膜時間之增加，可相對提高鍍膜層耐磨之時間。

關鍵詞：人工關節、類鑽碳膜、電漿離子浸沒注入沈積法、表面改質

Abstract

Wear debris arising from the counter-friction of UHMWPE element against metal is one of the major causes for the failure of joint arthroplasty. Previous studies reported that the hardness and wear problem could be improved by coating a diamond-like carbon film on the metal surfaces. The present study investigates the effects of film deposition time, bias voltage and composition of intermediate layer on the properties of the coated DLC film by the plasma immersion ion implantation technique. The results show that the film deposition rate decreases with the increase of bios voltage, which might be due to the high energy of the ion carried. Raman spectra analysis indicated that by increasing the bios voltages from 0.5 to 2KV, the deposited film tends to form more graphite-like structure. The surface hardness is increased by the coated DLC film while the elastic modulus decreases. By increasing the bios voltages from 0.5 to 2 KV, both of the hardness and elastic modulus are increased. Frictional tests show that surface coating of a DLC film will result in the decrease of dry friction coefficient and the increase of wet friction coefficient. By increasing deposition time, the endurance time against wear of the coated film will be increased.

Keywords: Artificial joint, Diamond-like carbon film, Plasma immersion ion implantation deposition (PⅢ-D) technique, Surface modification