牙科用鈦-鋯合金之微結構及性質研究

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摘 要

本實驗目的針對一系列Ti-Zr合金，添加四種比例Zr元素於商業用純鈦(c.p. Ti)金屬中，探討Ti-Zr二元合金之結構、機械性質和研削性研究，期開發可應用於牙科鈦合金。並利用SEM之能量分散式元素分析儀(EDS)觀察彎曲測試後合金之金屬基材與陶瓷間鍵結界面，並且分析Ti-Zr合金與c.p. Ti間之熱膨脹係數。 實驗結果顯示，所有Ti-Zr合金繞射峰皆符合α Ti，並未出現β相繞射峰。Ti-Zr合金系統的微硬度值，會隨著Zr元素的添加而增加，微硬度值範圍為266 HV (TZ1) 和350 HV (TZ4)之間。隨著Zr元素的添加，其彎曲強度、微硬度和彈性回復角皆呈現升高的趨勢，反觀彈性模數呈現降低趨勢，並且以TZ4的彈性回復角與c.p. Ti比較，可提高550%。每項金屬於研削性測試皆有主要的研削條件，以TZ4合金與c.p. Ti的低轉速條件比較，在研削量與研削比皆有提高。在500 m/min時，TZ4合金研削量是c.p. Ti的1.8倍，TZ4合金的研削比是c.p. Ti的1.6倍。由於TZ4合金有良好的機械性質、彈性回復能力及低轉速改進的研削性，故建議可將TZ4合金作為牙科加工性合金的潛力。 所有Ti-Zr合金的主要鍵結強度範圍為15.3 MPa (TZ4)和 25.1 MPa (TZ1)之間，以TZ1合金鍵結強度高於c.p. Ti，並為Ti-Zr二元合金系統最高鍵結強度。並且僅有TZ1合金鍵結強度高於三點彎曲測試的ISO 9693規範(25 MPa)。另一方面，觀察TZ3和TZ4合金經由燒結溫度並降溫的破斷試片表面。TZ4合金產生最大的彎曲現象，TZ1與c.p. Ti兩者無彎曲現象。而產生彎曲原因可能是合金與陶瓷經燒瓷後，兩者間熱膨脹不協調產生殘餘應力造成。所有Ti-Zr二元合金的熱膨脹係數的範圍為9.37 ×10-6/oC (TZ4) 和 9.88 × 10-6/oC (TZ1)之間，皆低於c.p. Ti(10.12 ×10-6/oC)。彎曲的產生傾向於隨著Zr元素的添加，合金和陶瓷間的熱膨脹係數增大而變化。藉此以TZ1合金與Duceratin瓷粉間的熱膨脹係數數值的差異且低於其他Ti-Zr合金，作為彎曲測試的參考依據。

關鍵詞 : 鈦金屬 ; 鈦合金 ; 微結構與機械性質 ; 瓷牙燒付 ; 熱膨脹係數 ; 研削性

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