生醫用鈦-鉻二元合金之結構及性質探討

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摘 要

本研究目的探討一系列Ti-Cr合金之微結構、機械性質及研削性，分別添加TiC1-TiC5的Cr於純鈦(c.p. Ti)中並熔融成合金，除此之外，並探討金屬/陶瓷之鍵結強度，藉由X光能量分散光譜儀(EDS)及熱膨脹係數分別來驗證經三點彎曲試驗後之破壞結構及金屬/陶瓷之熱膨脹係數差異。 實驗結果顯示出，c.p. Ti為六方晶體(hexagonal)結構之α相，TiC1合金有α相的繞射峰之外，也開始觀察出體心立方(bcc)結構之β相，隨著Cr元素含量增加到TiC2或更高時， α相完全消失只觀察到從高溫被殘留下的β相。由低掃描速度(0.5 deg/min)並觀察出TiC1合金有微量ω相的出現，TiC2合金則有大量的ω相且寬化。在微硬度方面，TiC2合金因有ω相使得微硬度也是一系列Ti-Cr合金中最高的，並且在研削性測試結果發現，微硬度與研削量有相似的趨勢。 在彎曲強度方面，TiC3合金擁有最高之彎曲強度(1484 MPa)，TiC2合金因有ω相的效應使得彎曲強度趨近於TiC3合金。經由彎曲試驗後之破斷面以SEM觀察後發現，TiC2合金表面呈現大劈裂面破壞結構，並且無發現韌窩(micro-dimple)結構。在彈性回復能力方面，與c.p. Ti相比較，TiC3合金彈性回復能力比c.p. Ti高出了460%，以光學顯微鏡觀察拋光後之試片表面形態發現，TiC3合金表面佈滿了滑移線，顯示出TiC3合金具延性結構。由機械性質與彎曲破壞後結構顯示出TiC3合金適合發展出鑄造牙科用鈦合金。 金屬/陶瓷之鍵結強度結果顯示出，除了TiC1合金外，其它一系列Ti-Cr合金之鍵結強度均大於c.p. Ti，且添加於TiC3於c.p. Ti後，鍵結強度均在25 MPa以上，並符合ISO 9693之最低標準(25 MPa)。藉由SEM觀察金屬/陶瓷表面破壞形態發現，c.p. Ti試片表面只有微量的瓷塊殘留，而TiC4與TiC5合金表面則有較多的瓷塊殘留，同時也證明出，瓷塊殘留的多寡似乎與金屬/陶瓷之鍵結強度有關。c.p. Ti及一系列Ti-Cr合金之熱膨脹係數結果顯示，Ti-Cr合金熱膨脹係數範圍在10.0×10-6/℃(TiC2)至11.8×10-6/℃(TiC5)之間，均比c.p. Ti高(10.1×10-6/℃)，同時也觀察出，TiC5合金熱膨脹係數趨近於瓷粉中的鍵結層陶瓷熱膨脹係數(12.5×10-6/℃)，並且也是一系列Ti-Cr合金鍵結強度最高的，因此可得知，金屬與陶瓷間若熱膨脹係數差異較小，則獲得較高的鍵結強度。

關鍵詞 : 鈦合金 ; 結構 ; 機械性質 ; ω相 ; 研削性 ; 鍵結強度 ; 熱膨脹係數

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