利用陽極氧化法於鈦合金表面製備奈米管陣列與生物活性表面之研究

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摘 要

本研究於鈦合金表面以陽極氧化法製作氧化鈦奈米管陣列。首先，於純鈦表面探討各種參數的影響，如電解液溫度、pH 值、濃度、工作電壓與反應時間，並觀察其表面形貌差異。結果顯示，其最佳參數分別為電解液溫度為常溫、pH 值P2、工作電壓V3、反應時間t9 與電解液濃度X1 S1 + Y2 S2。使用恆電位儀進行陽極氧化實驗，其工作電壓為V1 與V3，反應時間為t9。接著於T1℃、持溫t11小時進行熱處理，之後將熱處理後的試片浸泡於人工模擬體液(SBF)中ta、tb 和tc 天。此目的為評估此兩種材料製備出之不同奈米管內徑與管長對磷灰石形成之差異。最後使用場發射掃描式電子顯微鏡(FE-SEM)、能量散佈光譜儀(EDS)、X 光光電子能譜儀(XPS)與高解析X 光繞射儀(HR-XRD)分別觀察表面奈米管之微觀結構、化學組成元素與晶體結構。 結果顯示，當工作電壓從V1 遞增至V3 時，Ti 合金奈米管單孔直徑分別約為23~27 nm 與31~44 nm，管長則為550±20 nm 與700±20 nm；而c.p. Ti 奈米管單孔直徑分別約為24~30 nm 與35~53nm，管長則為590±20 nm 與730±40 nm。此外，陽極氧化處理後獲得之奈米管均為非晶質結構，此結構較不利於磷灰石的形成，需進行熱處理使其結晶方可誘導磷灰石的形成。隨後將非晶質的奈米管進行熱處理T1?鼎、持溫t11 小時使其產生銳鈦礦相。接著浸泡SBF tc天後，發現未陽極處理的Ti 合金與c.p. Ti 均無觀察到磷灰石的形成。另實驗指出Ti 合金經陽極處理V3 後於SBF 中浸泡ta 天即可觀察到部份的磷灰石形成。然而，兩者之氧化鈦奈米管經熱處理後浸泡於SBF tc 天，發現磷灰石均完全覆蓋於金屬表面，且以Ti 合金的磷灰石層最厚。Ti 合金與c.p. Ti 鈣磷層的厚度均隨電壓的遞增而逐漸變厚。Ti 合金經陽極處理V1 與V3，接著浸泡SBF tc 天後，此鈣磷層平均厚度分別為200±20 nm 與280±30 nm，而c.p. Ti 則為170±20 nm 與190±10 nm。

關鍵詞 : 鈦合金、陽極氧化、奈米管、生物活性、磷灰石、人工模擬體液

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