鋁箔電蝕時蝕孔衍生與腐蝕膜結構

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摘 要

本研究以電解模擬器，藉由精密訊號產生器與功率放大器輸出25Hz電流密度60A/dm2正弦波的交流電源，於鹽酸電解液中對鋁質電解電容器用鋁箔進行電化學腐蝕，同時量測電壓-電流關係。利用掃描式電子顯微鏡(scanning electron microscopy, SEM)觀察去除腐蝕膜前後之蝕孔表面形貌，並以橫截面穿透式電子顯微鏡(transmission electron microscopy, TEM)觀察蝕孔結構和腐蝕膜形貌與結構，並量測腐蝕膜重量和鋁箔溶蝕量。 結果顯示當鹽酸濃度增加時，鋁箔表面發孔面積會減少，未受侵蝕區域面積因而增加，同時腐蝕膜重量與鋁溶蝕量減少。橫截面TEM觀察發現蝕孔形貌逐漸由扁方轉變成直方，即蝕孔衍生擴展方式由側向擴展轉為垂直深入鋁底材，同時覆蓋在鋁箔表面腐蝕膜厚度亦減少。電壓-電流曲線發現，隨著鹽酸濃度增加，孔蝕電位下降，而同時每個週期蝕孔溶蝕時間遞減，蝕孔誘發時間遞增。在較高鹽酸濃度下觀察的較長蝕孔誘發時間與較短溶蝕時間說明鋁箔表面有較多未受侵蝕面積與較小的鋁溶蝕量。電量曲線顯示，隨著鹽酸濃度增加，所得到的單一電量和累積電量會降低。 在鹽酸中添加硫酸鈉後，發現硫酸根會抑制侵蝕初期的蝕孔產生，隨著硫酸根增加，直方形蝕孔的比例遞增。同時在0.8M鹽酸中添加硫酸鈉時，隨著硫酸根濃度增加，孔蝕電位升高，溶解時間減少，誘導時間增加。相反地，在3.2M鹽酸中添加硫酸鈉後，孔蝕電位、溶解時間與誘導時間的變化必不明顯。硫酸鈉濃度的增加，會促進每一個週期所得到的單一週期電量及累積電量增加。 在0.8M鹽酸中添加2.4M氯化鈉電解液中鋁箔發孔型態和0.8M鹽酸中較為接近。同時腐蝕膜重量和鋁溶蝕量介於0.8M鹽酸和3.2M鹽酸中的結果。又孔蝕電位、溶蝕時間及誘導時間的結果與0.8M鹽酸中的結果較為接近。添加了氯化鈉會提升每個週期所得到的總電量。

關鍵詞 : 電解電容器，電蝕鋁箔，腐蝕膜，孔蝕電位，溶蝕時間

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