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Surface structural analyses on elemental ratio and depth profile of Ti metal subjected to heat treatment in N_2 atmosphere after alkali and acid treatments

Alireza Valanezhad

Chubu University, Japan

Abstract

It is important for electrodes for electrochemical reactions such as fuel cell or solar cells to show high total surface area, electrical conductivity and catalyst fixation ability on their surfaces. In the present study, pure Ti metal was soaked in 5 M-NaOH aqueous solution at 60°C for 1 h, then in 0.5 mM HCl solution at 40°C for 3 h and heated at 600-1000°C in N_2 gas for 1-12 h. The surface structural changes, especially about the effect of temperature and duration time of heat treatment on the incorporation of elements N, electrical conductivity were studied.

After chemical and heat treatments, a porous nano network structure with high surface area mainly composed of Ti oxides such as anatase, Ti-oxynitride and Ti nitrides such as Ti_2N with about 600 nm in thickness was formed on their surfaces. It is revealed by X-ray photoelectron spectroscopy analyses on elemental ratio and depth profile that the N was incorporated preferentially into the deep dense region below the network layer at low heat treatment temperature, but incorporated more and more into the network structure at top surface at higher temperature or for longer period. It was also revealed that their conductivities increased with increasing N incorporation amount and that the treated Ti metal can fix some redox catalyst on its surface and work electrochemically.

Conclusively, the Ti electrode with high specific surface area, conductivity and catalyst fixation ability on its surface can be prepared by heat treatment in N_2 atmosphere after alkali and acid treatments.

Biography

Alireza Valanezhad received a Ph.D. in biomaterials from Kyushu University Japan. Began his career as a lecturer in Sahand University of Tabriz. He became assistant professor of Kyushu University Japan in 2011 and followed as a research staff of Chubu University Japan at the present time. Interests are surface, coating, modification, energy materials, nanotechnology and biomaterials.