学 位 論 文 内 容 の 要 旨

DISSERTATION ABSTRACT

博士の専攻分野の名称　博士（工学）　氏名　薛 超瑞

学 位 論 文 題 名

Title of dissertation submitted for the degree

TiO_2 Nanotube Arrays Prepared by Anodizing in Water-Glycerol Electrolyte and Their Photocatalytic Properties

(水-グリセリン系電解液中での陽極酸化によるチタニアナノチューブアレイの合成とその光触媒特性)

TiO_2 has attracted much attention in the last decades owing to their superior positions as biomaterials, in photocatalytic applications, and in dye-sensitized solar cells (DSSCs). For the photocatalytic application of TiO_2, The generation of electron–hole pairs and their oxidative nature provide manifold applications, such as the decomposition of organic pollutants in water and air. Not only the material but also its structure and morphology can have a considerable influence on the photocatalytic performance of TiO_2. Thus, over the past few years, considerable progress was made particularly in optimizing the nanoscale morphology of TiO_2.

Most recently, a novel 1D nanotube structure, a TiO_2 nanotube array, has been shown to be highly competitive and in many cases favorable to achieve enhanced photocatalytic performance. The cheapest and most straight-forward methods that lead to ordered TiO_2 nanotube array are anodization techniques. In particular, the self-organizing anodization approach allows an easy control on the dimensions of the anodized TiO_2 nanotube arrays (layer thickness, pore diameter, interpore distance). Valuable properties of TiO_2 nanotube arrays, like semiconductive behavior, photocatalytic and photoelectrochemical properties, can be enhanced by controlling their geometry. In ethylene glycol-containing electrolyte, by controlling the anodization conditions, many types of TiO_2 nanotubes (e.g. ripples free, double-wall) can be formed. However, detailed investigations about these special structures in glycerol-containing electrolyte have not been fully performed yet.

In this context, the preset thesis focuses on revealing the critical mechanisms and anodization conditions to form TiO_2 nanotube arrays with various nanostructures (for example, double-wall and ripples) in glycerol-based electrolytes. Based on the acquired structures of anodized TiO_2 nanotube arrays, the annealing effect on the morphology, chemical composition and structure of double-wall TiO_2 nanotube arrays was further investigated by both ex situ and in situ TEM annealing method. “Fluoride-rich” layer was confirmed in between the double-wall nanotubes. For the in situ TEM annealing, gases can be introduced into the TEM column, the in situ TEM sintering behavior of double-wall TiO_2 nanotubes was compared with and without oxygen gas. Furthermore, the photoctalytic activities of single- and double-wall TiO_2 nanotube arrays were compared, Pt decoration inside both single- and double-wall TiO_2 nanotube arrays was also examined to enhance their photocatalytic activities.