主　論　文　の　要　約

論文題目　Fabrication and Growth Mechanism of Metal Oxide Flower/Grass-like Nano Architectures Based on Catalyst-Assisted Thermal/Room Temperature Oxidation（触媒支援型熱/室温酸化による金属酸化ナノアーキテクチャの作製と成長機構の解明）

氏　　名　胡　　立教

In this thesis, the first main purpose is to propose a novel and universal method for the fabrication of metal oxide and carbon-metal oxide 3D FGLNAs nano structure. a creative stress-induced method for growing Cu_2O and ZnO FGLNAs is presented. The length to width ratio of Cu_2O FGLNAs petals/leaves can be manipulated by adjusting the heating temperature. The heating temperature is suggest to be 120-240 ° C for Cu_2O FGLNAs and 200 ° C for ZnO FGLNAs. In addition, large scale growth of metal oxide nano architecture was succeeded through controlling the humidity and surface condition, such as surface roughness, surface stress and grain size. Influence of humidity is of crucial importance in the development of metal oxide nano architectures. However, certain humidity, 55-75%, is enough for the growth of FGLNAs and the decreasing or increasing of humidity did not have obvious effect on the growth density of FGLNAs. Catalytic activity of nickel for the oxidation taking place on various metal oxide nano architectures was investigated. The volume of catalyst has an effect on the growth of FGLNAs. Higher volume of nickel leads to short heating time and higher density of FGLNAs. Carbon-metal oxide hybrid FGLNAs were fabricated successfully using novel room temperature catalyst assisted oxidation method under proper humidity environment and the weight content of metal oxide in carbon-metal oxide hybrid FGLNAs have been successfully increased, which is the main issue for carbon-metal oxide nanocomposite materials. Meanwhile, the high cost problem of incorporating carbon nanotubes into carbon-metal oxide nanocomposite materials was solved by using the cheap and universal method proposed in this study. Growth mechanism of the Cu_2O/C and ZnO/C hybrid FGLNAs were investigated based on catalyst-assisted room temperature oxidation. The main text of this dissertation was organized into seven chapters.

Chapter 1 describes research background and nanotechnology, nanomaterial, and research purpose in this dissertation.

Chapter 2 proposes the detailed catalyst-assisted thermal oxidation fabrication method for the fabrication of metal oxide FGLNAs. In particular, the length to width ratio control of Cu_2O FGLNAs petals/leaves is given in detail. Moreover, the component and characterization of as-obtained FGLNAs are also analyzed using SEM, EDX, XRD, TEM and EELS. For morphology control of FGLNAs, adjusting the heating temperature was proposed.

Chapter 3 proposes the growth mechanism of metal oxide FGLNAs based on catalyst-assisted thermal oxidation and the effects of the surface conditions, such as residual stress, surface roughness and grain size, on the growth of Cu_2O FGLNAs.

Chapter 4 describes the fabrication of Cu_2O and ZnO FGLNAs on Cu and Zn powders using catalyst-assisted thermal oxidation method. The experimental fact that metal powders can replace metal foil and film for the growth of FGLNAs further proved that the growth mechanism is based on oxidation extension rather than thermal expansion induced stress. In addition, over lapping migrations (OLM) of Cu, Zn powder specimens and toothpaste squeezing migration (TSM) of Al powder specimen caused by different molecules density were proposed in this chapter.

Chapter 5 presents fabrication of carbon-metal oxide FGLNAs based on catalyst-assisted room temperature oxidation. Evaluation of carbon-metal oxide FGLNAs were also carried out by EDX, TEM and EELS. The growth mechanism was also discussed.

Chapter 6 elaborates photovoltaic application, in which dark current curve and photovoltaic current density-voltage curve were measured.

Finally, the summary of the most important conclusions of this research is presented in chapter 7.

The work presented in this dissertation is mostly focused on the fundamental study about the fabrication, growth mechanism and application of metal oxide FGLNAs and carbon-metal oxide hybrid FGLNAs. In order to fabricate metal oxide FGLNAs, thermal/room temperature catalyst assisted oxidation method under proper humidity environment was proposed. The contribution of the study in this thesis is using a universal method to fabricate metal oxide FGLNAs and carbon-metal oxide hybrid FGLNAs. The typical photovoltaic effect of the Cu_2O/Cu multilayer structure based on Cu_2O FGLNAs was demonstrated, which makes it to be potential option for cheap and low toxicity photovoltaic devices with good environmental acceptability.