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Welcome

Encouraged by the success of the 1st and 2nd IEEE International NanoElectronics Conference (INEC) held in Singapore in 2006 and Shanghai in 2008, the 3rd INEC is held in City University of Hong Kong from January 3 to 8, 2010. Extensive research on nanomaterials has unveiled many interesting and promising materials properties for novel applications in electronics, photonics, and biology. In order to benefit mankind for such discoveries, it is necessary to cross the chasm between nanomaterials and nanodevices and their applications. This effort requires a multi-disciplinary approach combining research in materials design, processing, modeling, characterization, and metrology. Commercialization of nanotechnology is also important to fuel future research. The aim of this conference is to identify the paths between fundamental research and potential electronic, photonic, and biological applications. INEC2010 provides a forum for international academics, researchers, practitioners, and students working in the areas of nanofabrication, nanoelectronics, nanophotonics, and nanobiology to discuss new developments, concepts, and practices, and to identify future research needs so that nano-research can be brought closer to its immense potential.

INEC2010 features 4 plenary and 22 invited talks by international scientists in nanofabrication, nanoelectronics, nanophotonics, and nanobiology. A special symposium on nanoscience and nanotechnology in China is held during the conference to foster further scientific exchange between scientists from Greater China and other parts of world. We are very fortunate to have 16 academicians of the Chinese Academy of Sciences, Chinese Academy of Engineering, and Academia Sinica to give presentations in this special symposium.

INEC2010 is the largest one of this growing event. We are very pleased to have received 911 contributed abstracts including 503 oral and 408 poster presentations from 35 countries and special administrative regions.

Hong Kong being a vibrant and modern city where east and west meet is very exciting. The city offers superb dining and attractions and boasts one of the most impressive skylines in the world. In addition to the technical events, I urge you to experience and enjoy our unique city.

Paul K Chu
General Chair
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Effect of Annealing on the Properties of P-Type Nano Zn_{0.92}Mn_{0.08}O:N Films
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Fabrication and Photoelectrochemical Properties of Nanoporous WO_3 Film
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Direct growth of Nb_2O_5 Nanobelts on Nb Foil
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Preparation and properties of p-type semi-transparent conductive nickel oxide films
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Investigations on Growth and Hydrogen Gas Sensing Property of ZnO Nanowires Prepared by Hydrothermal Growth
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Growth and Optical Properties of ZnO Nanorods Prepared through Hydrothermal Growth Followed by Chemical Vapor Deposition
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Direct growth of Nb$_2$O$_5$ Nanobelts on Nb Foil

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Abstract—Self-organized Nb$_2$O$_5$ nanobelt scaffolds and quasi-aligned bamboo slip-like Nb$_2$O$_5$ nanobelt arrays have been directly fabricated on Nb foils by a hydrothermal reaction in an alkaline solution followed by protonation and annealing. The length and width of the nanobelts can be controlled by varying the fabrication parameters such as reaction temperature, alkaline concentration, and reaction time. The morphology, structure, and composition of the nanobelts were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray photoelectron spectrometry (XPS).

INTRODUCTION

One-dimensional (1D) transition metal oxide nanostructures have attracted considerable attention due to their unique properties and very promising applications in field emission devices [1], Li-ion batteries [2], biomedical materials [3], and sensors [4]. Niobium pentoxide (Nb$_2$O$_5$) is the thermodynamically most stable Nb-based oxide phase, which has a high band gap as well as good physical and chemical properties and has important applications in many fields including catalysis [5], sensing [6], Li-ion batteries [7] and biomedical materials [8]. However, little attention has been paid to the fabrication of 1D Nb$_2$O$_5$ nanostructures [5, 9-11] in comparison with its counterparts of TiO$_2$ or WO$_3$. In this work, quasi-aligned bamboo slip-like Nb$_2$O$_5$ nanobelt arrays and self-organized nanobelt scaffolds are directly fabricated on Nb foils by a hydrothermal reaction of the Nb foils in an alkaline solution with subsequent protonation and annealing treatment.

The Nb foil serves as both the Nb source and growing substrate. The morphology and size (lengths and widths) of the nanobelts can be controlled by varying the fabrication parameters such as reaction temperature, alkaline concentration, and reaction time. The nanostructures are characterized and the corresponding growth mechanism is proposed.

CURRENT RESULTS

In a typical synthesis process, the Nb foil was firstly polished with SiC sandpapers and then ultrasonically cleaned in acetone, ethanol, and deionized water sequentially, and then dried under flowing N$_2$. The pre-treated Nb foil was subsequently immersed into 40 ml of an alkali solution in a 60-ml Teflon-lined stainless steel autoclave. The autoclave was sealed and maintained at 180 °C for 16-48 h. After the autoclave cooled naturally to room temperature, the sample was taken out from the solution and rinsed with distilled water and ethanol several times, followed by drying at 60 °C for 4 h in air.

Fig. 1a shows the SEM images of self-organized niobate nanobelt scaffolds prepared by the hydrothermal treatment of Nb foil in 0.5 mol/L NaOH at 60 °C for 36 h. The nanobelts having widths of 30-60 nm and lengths of several tens of micrometers are interwoven together on the Nb foil to form scaffold-like structures (Fig. 1a). EDS analysis suggests that the nanobelts are composed of Na, Nb, and O. If the concentration of the alkaline solution is constant but the reaction temperature is increased, the formed nanobelts peel off from the Nb foil. Thus, we use a smaller concentration alkaline solution to fabricate the niobate nanostructures but at the higher temperature. Fig. 1b shows the products on the Nb foil prepared in a 0.02 mol/L KOH solution at 170 °C for 16 h. The morphology of the products shown in Fig. 1b is different from that depicted in Fig. 1a prepared at a lower temperature and more concentrated alkaline solution. The nanobelts in Fig. 1c look like bamboo slips that used for writing in ancient China. The bamboo slip-like nanobelts are quasi aligned on the Nb foil with widths of 300-500 nm and lengths of about several microns.

The as-obtained niobates are soaked in a HNO$_3$ solution for 12 h to form protonated niobate and then annealed at 600 °C for 3 h to transform into Nb$_2$O$_5$ products. SEM images (not shown here) indicate that the Nb$_2$O$_5$ product morphology resembles that of the initial niobate although they go a two-step severe treatment of protonation and annealing. X-ray diffraction patterns (Fig. 2) confirm that the product is orthorhombic Nb$_2$O$_5$ (PDF file, No.27-1003). No perks of niobate can be found, suggesting that niobate is fully transformed into Nb$_2$O$_5$ after protonation and annealing. The XPS spectra further corroborate that the products of self-organized nanobelt scaffolds and quasi-aligned bamboo slip-like nanobelt arrays (Fig. 3) are high purity Nb$_2$O$_5$. The Nb3d$_{5/2}$ peak in Fig. 3b located at a binding energy of 207.5 eV indicates that Nb exists in the form of Nb$_2$O$_5$.

In brief, self-organized Nb$_2$O$_5$ nanobelt scaffolds and quasi-aligned bamboo slip-like Nb$_2$O$_5$ nanobelt arrays have been fabricated on Nb substrates directly by a hydrothermal reaction and subsequent protonation and annealing. Such Nb$_2$O$_5$ nanostructures have important applications as photocatalyst and biomedical materials, which are being investigated in our laboratory.

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