Fabrication of AgCl and Ag nanowires

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Abstract

In this work, a new and novel method was developed to fabricate nanowires array by template method. One dimensional AgCl nanowires were synthesized in the channels of AAO template by diffusion convection. Meanwhile Ag nanowires were prepared through the same method which indicates that the novel mehod could also be further applied to synthesis of other materials nanowires.

Introduction

One dimensional nanomaterials, including nanowires, nanobelts, nanotubes and nanorods, have attracted extensive research interest for their potential applications in various fields such as electronics, magnetism and optics due to their unique physicochemical and chemical properties compared to the bulk counterparts.

So far, a variety of nanowires of metals, semiconductors, polymers and other materials were successfully fabricated by various methods such as solution method[1], chemical vapor deposition (CVD)[2], and template method (hard or soft)[3-7]. Among all of these methods the use of hard template which entails fabrication of a desired material within the pores has been proved to be a versatile and inexpensive technique. Anodic aluminium oxide (AAO) template is one of the preferable templates because of its advantages of high pore density, uniform pore distribution and tuneable pore diameters.

AgX (X=Cl, Br, I) is a semiconductor having applied to various fields such as photographic materials[9], catalyst[10], photochromic materials[11], superionic conductor[12] and so on. And Ag is a well-known conductor which was often used in electronic, magnetic and optical fields.

Results and Discussions

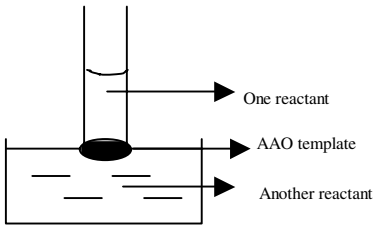

Fig.1. *the schematic diagram for the fabrication of nanowires*

AgCl nanowires fabrication

In the course of experiment, as showed by Fig.1, NaCl serves as one reactant on a side of the template while AgNO3 serves as another reactant on the opposite of the template, then the two reactants transport into the nanochannels of AAO template by converse diffusion. NaCl aqueous solution flows down into the nanochannels whereas AgNO3 aqueous solution ascends due to the capillarity and then encountered each other to synthesize AgCl nanowires. The nanochannels of AAO template act as the nanoreactor, which confine the growth of AgCl nanowires. SEM images of well arrayed AgCl nanowires are seen in Fig.2.

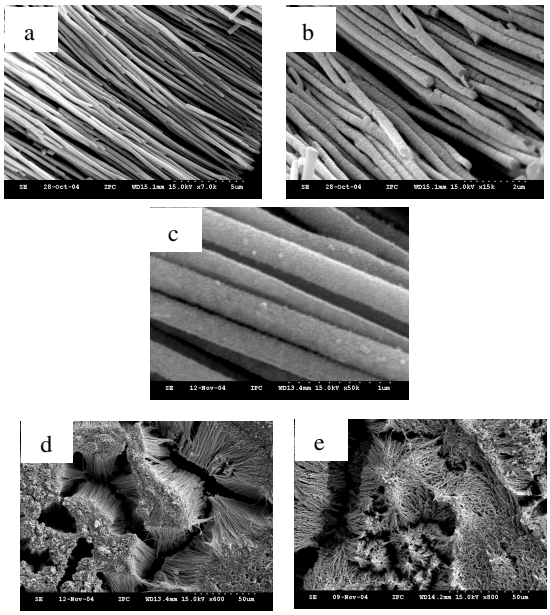

Fig.2. *SEM images of AgCl nanowires array: a) -b) cross view; c) magnified of a); d)-e) top view*

It could be seen that the AgCl nanowires are smooth, highly ordered with uniform diameter distribution and the diameter and the length is 200 – 400 nm and ca. 60 mm respectively, which accord well with the channel size of the AAO template.

Ag nanowires fabrication

In this paper there are two methods to fabricate Ag nanowires array.

One method is that Ag nanowires (Ⅰ) were synthesized by reducing $AgNO_3$ using $NaBH_4$ as reducing agent via AAO template which is the same method to that of AgCl nanowires fabrication. (Seen in Fig.1)

Through SEM observation it clearly showed that Ag nanowires (Ⅰ) are highly ordered along the direction of the pore of AAO template (Fig.3). This result indicates that the novel method could be applied to fabrication of other materials nanowires.

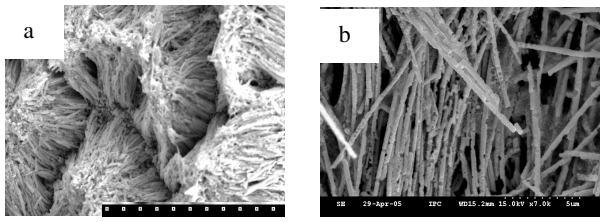

Fig.3. *SEM images of Ag nanowires (Ⅰ) array*

The other method is that Ag porous nanowires (Ⅱ) can be gained by reducing AgCl nanowires using $NaBH_4$ as a reducing agent, in this method AgCl nanowires were used as template which defined the growth of Ag nanowires.

In Fig.4. It clearly showed that the morphologies of Ag nanowires (Ⅱ) are different from that of Ag nanowires (Ⅰ).

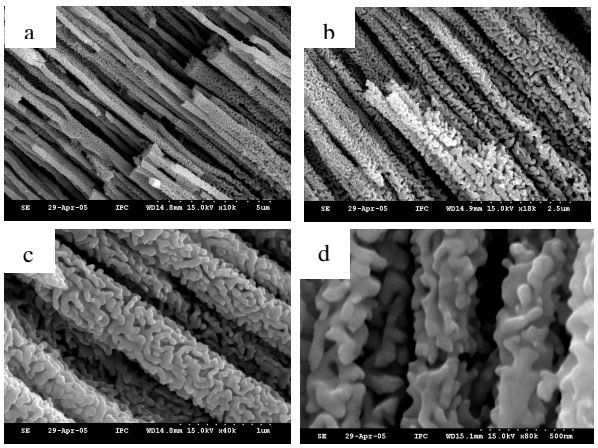

Fig.4. *SEM images of Ag nanowires (Ⅱ) array with different magnification*

The nanowires were characterized using energy dispersive spectroscopy (see Fig.5) and the result validate that the nanowires are comprised of Ag element.

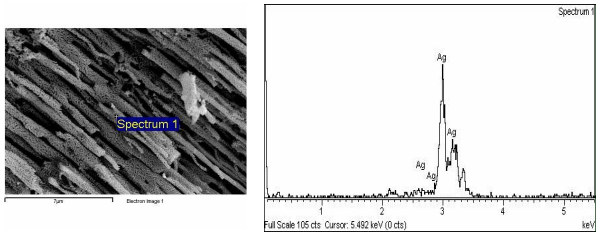

Fig.5. *EDS analysis of Ag nanowires array*

Conclusions

In this paper a facile template method was developed to fabricate AgCl and Ag nanowires arrays. And there are different morphologies of Ag nanowires were fabricated by two different methods. Ag nanowires (Ⅰ) were smooth and highly ordered along the direction of the pore of template, while Ag nanowires (Ⅱ) were porous and there are so many holes in the surface of nanowires. The fabrication of Ag nanowires (Ⅱ) would gradually expand its applications in many fields

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Author Biography

Chenghua Sun received her PhD in physical chemistry from Technical Institute of Physics and Chemistry of CAS (2005). Since then she has worked in the same institute and her work has focused on the spectral sensitization and the fabrication of AgCl, Ag and other materials nanowires array.