Synthesis and characterization of Ag nanoflowers with different morphologies

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Abstract. In this paper, the chemical reduction method was used to prepare silver nanoparticles with different morphologies and sizes by controlling the proportion of ascorbic acid and silver nitrate at room temperature. In the experiment, the molar ratio of ascorbic acid and silver nitrate was mainly 1:1, 1:2, 1:4, 1:8, 2:1, 4:1 and 8:1 to prepare nano silver. The morphology of silver nanoparticles was observed by scanning electron microscopy (SEM) and the phase content was determined by X-ray diffraction (XRD). The results show that the obtained material is pure silver nanoparticles, and the silver nanoparticles are spherical and multilevel branched.

1. Introduction

In recent years, noble metal nanoparticles have been widely used in photonics [1], microelectronics [2], information storage, catalysts [3-6], energy conversion [7] and other fields. Among all nanoparticles, silver nanoparticles play an important role due to their unique chemical properties and excellent biological activity, and have the most effective surface enhanced Raman scattering (sere) effect in the visible region [8-9]. In the context of the development of information technology, nanotechnology has made groundbreaking achievements in many fields. It is of great theoretical significance and potential value to carry out basic research on nanotechnology [10-11].

Nano silver is a kind of powder with particle size less than 100 nm, which can be synthesized by physical and chemical methods. The chemical method has the advantages of easy control of experimental conditions, easy operation and easy access to products, so it is widely used to synthesize silver nanoparticles with good performance. Compared with traditional metal nanoparticles, nano silver has strong advantages in antibacterial property [12-13], surface activity and catalytic performance, so it is widely used in medicine, catalyst, electronic industry, textile industry, agriculture, detection and other fields. Because of its high antibacterial activity, nano silver has become a new star in the field of nano materials research; moreover, it has the advantages of low price and high performance price ratio, which is more suitable for industrial application than other nano materials. Nano silver materials are widely used. We can design and prepare nano silver materials with specific morphology and size, so as to improve the utilization efficiency of nano materials. Based on this, this paper aims to synthesize silver nanoparticles with different sizes and morphologies by the molar ratio of ascorbic acid to silver nitrate.
2. Experimental part

2.1. Experimental reagents and instruments

The reagents and instruments used in the test are listed in Table 1 and table 2 respectively.

| Name of drug       | purity  | Manufacturer                                      |
|--------------------|---------|---------------------------------------------------|
| AgNO₃              | 99.8%   | International Group Chemical Reagent Co., Ltd     |
| L-ascorbic acid (c)| 99.7%   | International Group Chemical Reagent Co., Ltd     |

| Instrument name                          | purity  | Manufacturer                                      |
|------------------------------------------|---------|---------------------------------------------------|
| Analytical balance                       | BS221S  | Beijing saiduolis balance Co., Ltd                |
| Desktop centrifuge                       | H1650-W | Xiangyi company                                   |
| Drying oven                              | GZX-GF101-1-BS-II | Shanghai Yuejin Medical Equipment Co., Ltd |
| Field emission SEM                       | Quanta FEG 250 | USA, FEI company                                |
| X-ray diffractometer                     | D/MAX-3BX | Japan, RIGAKU                                    |

2.2. Experimental steps

10 mL of 1.0 mol / L silver nitrate solution was mixed with 10 mL of 1.0 mol / L ascorbic acid solution at room temperature and stirred. When the ascorbic acid solution was added into silver nitrate solution, the solution turned to gray black turbid liquid, and then turned to gray yellow, and a large amount of precipitation was formed in a few minutes. Then the molar ratio of ascorbic acid and silver nitrate was changed. In this experiment, seven groups were made, which were 1:1, 2:1, 4:1, 8:1, 1:2, 1:4, 1:8. The precipitates were centrifuged and cleaned with distilled water, and centrifuged at 8000 r/min for six minutes. After centrifugation, the precipitates were dispersed in water to prepare for further characterization. The phase of the samples was measured by D/MAX-3B X-ray diffractometer and the morphology was observed by field emission scanning electron microscope.

3. Results and discussion

Figure 1 shows the XRD pattern of silver nanoparticles. Scanning angle 2θ was performed from 30° to 80°. The diffraction planes shown are (111), (200), (220), (311), which are in good agreement with the standard PDF card (#65-3107). The results show that the material is pure silver nanoparticles.
Figure 2. (a), (b), (c), (d), (e), (f) and (g) are respectively [Vc] : [AgNO3] is 1:1; 2:1; 4:1; 8:1; 1:2; 1:4 SEM image.

Figure 2 shows the SEM images obtained when the molar ratio of ascorbic acid to silver nitrate is different. It can be seen from Figure 1 that the silver microcrystals obtained by changing the molar ratio of ascorbic acid to silver nitrate (MR) are different. When the molar ratio of ascorbic acid to silver nitrate is reduced from 1:2 to 1:4 and 1:8, it can be seen that the size of silver nanoparticles increases significantly and the morphology does not change. However, when the molar ratio of ascorbic acid to silver nitrate increased from 2:1 to 4:1 and 8:1, the number of silver microcrystals with dendritic hierarchical structure decreased.

4. Conclusion

The unique structure and properties of silver nanoparticles have attracted much attention. Ascorbic acid is both a reducing agent and a crystal growth regulator in this experiment. The core idea of this paper is to study the effect of ascorbic acid content on the morphology and size of silver nanoparticles. In this paper, the preparation and characterization of silver nanoparticles are discussed. In this paper, we use ascorbic acid as reducing agent to prepare silver nanoparticles at room temperature. It is known from the experiment that different [Vc]: [AgNO3] molar ratio plays an important role in the structure of silver nanoparticles, and the size and morphology of silver nanoparticles obtained by different ratios are completely different. It can be seen from SEM images that in order to prepare graded silver microcrystals, 2:1 molar ratio of [Vc]: [AgNO3] is the best, and the distribution of silver microcrystals under this ratio is relatively uniform. The XRD results show that the samples are pure silver nanoparticles.

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