ZnO NANORODS FABRICATED BY A WET CHEMICAL METHOD

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In recent years, one-dimentional (1D) nanostructures in the form of nanorods, nanowires or nanotubes, appear as an exciting research area for their great potential of applications. Zinc oxide is a versatile material with many applications including transparent electrode in solar cells, gas sensors and photo-luminescence devices [1-3]. Recently, strong efforts have been made to fabricate one-dimensional ZnO synthesized, for example, by the high-temperature physical evaporation, the micro emulsion hydrothermal process and the template induced method [4-6]. Among all these methods, the solution-based synthesis, by thermal treatment of reactants in different solvents, maybe the most simple and effective way to prepare sufficiently crystallized materials at relatively low temperatures. Also, the benefits of utilizing solution-based method have also involved a basic understanding upon the substantial influence of reaction species on the size and morphology as well as effective and economic preparation. In this aspect, many of the previous investigations on ZnO prepared by solution based method, mainly utilized zinc hydroxide or salt as precursors and water or organic solvent as reaction media. Only few publications reported the relationship between amphiphile structure and ZnO nanorods morphologies. Herein, we present microemulsion method toward the growth of well-proportioned and crystallized ZnO nanorods using two types of amphiphiles in figure 1 as the modifying and protecting agents to evolve the morphological changes upon the difference of amphiphiles. The synthesis of ZnO nanorods was carried out in microemulsions, which consisted of 5g of each amphiphile such as isopropyl naphthalene sulfonate or sodium lauryl sulfonate and 2 mmol of $ZnAc_2 \cdot 2H_2O$ dispersed in 60 ml xylene by stirring until a homogenous slightly-turbid appearance of mixture was obtained. Then, hydrazine monohydrate 2 ml and ethanol 8 ml mixture solution was added drop-wisely to the well-stirred mixture at room temperature by simultaneous agitation. The resulting precursor-containing mixture was subsequently heated to the 140 for refluxing. After refluxing for 5 hours, a milky-white suspension was obtained and centrifuged to separate the precipitate, which was rinsed with absolute ethanol and distilled water for several times and dried in vacuum oven at 70 for 24 hours. These as-prepared products were used for characterization. X-ray powder diffraction (XRD) analysis was conducted on a Rigaku D/max-2500 X-ray diffractometer. Room temperature fluorescence measurement was carried out on a JASCO FP-6500 fluorescence spectrophotometer at room temperature with a Xe lamp as the excitation light source. The excitation wavelength used was 325nm. The sample morphology was examined by field emission scanning electron microscopy (FE-SEM). On the basis of XRD patterns (Figure 2), the crystallographic phase of both samples belongs to the Wurtzite-type($P6_3mc$), reflecting that all the samples are well-synthesized to single phasic ZnO. On the other hands, the morphologies of both ZnO nanorods appeared to be quite a little different in length, aspect ratio and aggregations according to the type of amphiphiles (short aromatic amphiphile and long aliphatic surfactant) in Figure 3. It may be understood due to the fact that the difference of structural and chemical properties between two amphiphiles leads to the difference in emulsion phases and it will be discussed.

References:

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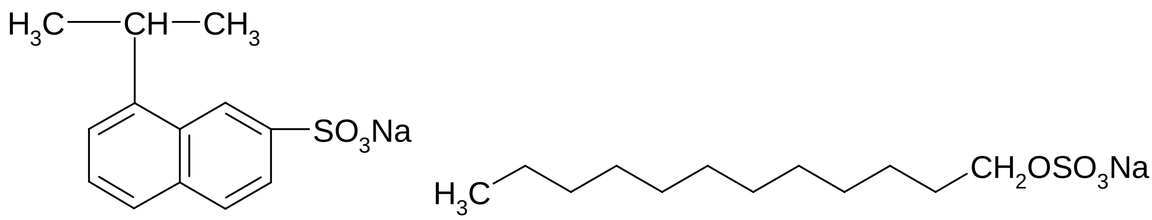
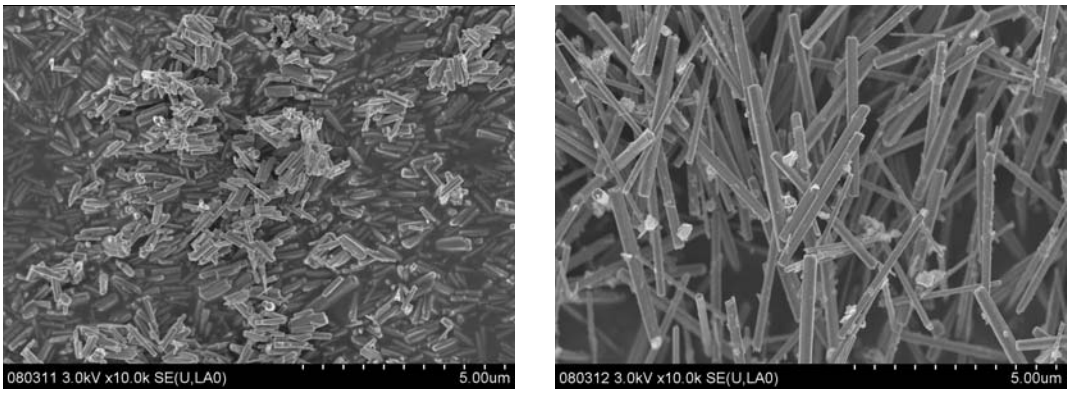
Figures:



(a) (b)

Figure 1. Molecular structures of the amphiphiles: (a) isopropyl naphthalene sulfonate, (b) sodium lauryl sulfonate.



(a) (b)

Figure 3. FE-SEM images of the ZnO nanorods at different amphiphiles: (a) isopropyl naphthalene sulfonate, (b) sodium lauryl sulfonate.

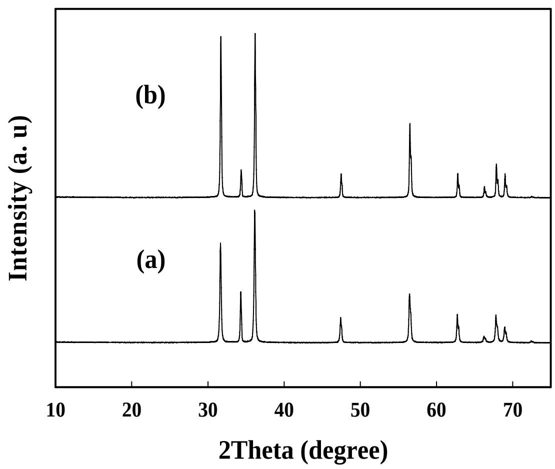


Figure 2. XRD patterns of the ZnO nanorods at different amphiphiles: (a) isopropyl naphthalene sulfonate, (b) sodium lauryl sulfonate.