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# STUDY ON CHEMICAL STABILITY OF ALKALINE EARTH SULFIDES (MS)

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**Abstract** In this paper, MS (Ca, Sr etc.) were prepared which demonstrate higher chemical stability. The possible mechanisms are discussed.

**Keywords** Alkaline earth sulides (AES); Indirect bandgap semiconductor; Crystallinity; Chemical stubility

## 0 Introduction

Alkaline earth sulfides (AES), a group of wide and indirect bandgap ⅡA—ⅥA semiconductors[1], are gaining increasing importance recently because they, when properly doped with rare earth ions, promise great potentials in a variety of improtant modern optronic and photonic applications such as erasable optical memory elements, infra-red detecting/imaging devices, color TFFL (thin film electroluminescence) devices and HDTV (high definition TV), etc.[2,3]. A novel electron trapping material (ETM) was synthesized in our laboratory by doubly doping AES with rare earth ions[4]. The ETM can hold optical information for more than 100 hours and upconvert infra-red light of wavelengths from 0.8～1.4μm into visible light of wavelengths from 0.4～0.6μm at room temperature[4].

One of the key issues to successful applications of the meterials is how to grow well-crystallized and chemically stable AES. Such quality AES were prepared thanks to an optimized method developed in our laboratory.

## 1 Experimental

The matarial preparative process used in this study is basically similar to the sulfurizing flux method for rare earth oxysulfides. The precedures are as follows:

Starting mixture→Mixing/Milling→Preheating at LT→Heating at HT→Cooling→Pulverization→Washing→Drying→Annealing→Post-Treatment. Where LT stands for low temperatures (～500—700℃) and HT, high temperatures (～

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(~800—1,200℃). The AES thus prepared is designated as Sl. The AES are conventionally grown with $H_2$ or $H_2S$—reduction method with which the same material as S1 was also prepared in this study, designated as S2, for purpose of comparision.

S1 and S2 were investigated by means of XRD (X-ray diffraction) and thermal analysis. The X-ray diffractomter was D/max-rA. Cu/$K_\alpha$, $U=45$kV, $I=80$mA. The thermal analysers were Perkin-Elmer DELTA SERIES A7 and DTA 1700. The thermal analyses were effected in ambient atmosphere.

## 2 Results and Discussion

The FWHMs of XRD patterns for S1 and S2 are given in Table 1. The thermograms for S1 and S2 are shown in Fig. 1 and Fig.2 respectively.

**Table 1 The FWHMs of XRD Patterns for S1 and S2**

| Plane Indices | | (200) | (220) | (222) | (400) |
|---|---|---|---|---|---|
| $2\theta$ (degrees) | | 31.427 | 45.031 | 55.937 | 65.597 |
| D-Value | | 2.844 | 2.011 | 1.642 | 1.421 |
| FWHM (degrees) | S1 | 0.300 | 0.300 | 0.300 | 0.300 |
| | S2 | 0.340 | 0.360 | 0.380 | 0.380 |

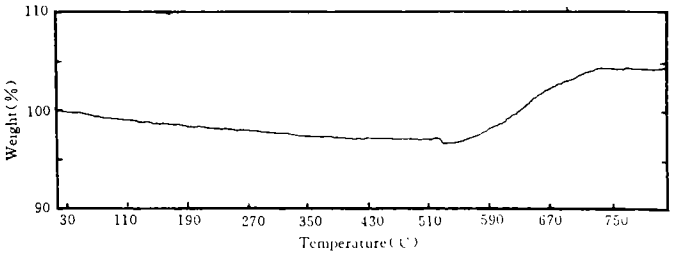


Fig. 1. The TGA curve for Sample 1 in air.

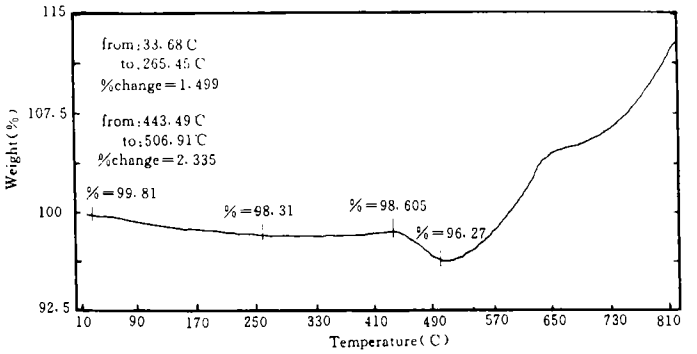


Fig. 2. The TGA curve for Sample 2 in air.

It is obvious from Table 1 than the FWHMs for S1 are smaller than those for S2, indicating that S1 has better crystallinity than S2. Fig.1 clearly demonstrates that a larger weight gain occurs in S2 than in S1 on heating in a ambient, which means S1 is more chemically stable than S2. Taking into consideration of other evidences such as XPS (X-ray photoelectron spectroscopy) spectra[5], the major reactions involved in S2 and S1 on heating are possibly as follows:

$$MS + H_2O \rightarrow MO + H_2S\uparrow, \qquad \Delta < 0$$
$$MS + 2H_2O \rightarrow M(OH)_2 + H_2S\uparrow, \qquad \Delta > 0$$
$$MS + 3H_2O \rightarrow MSO_3 + 3H_2\uparrow, \qquad \Delta > 0$$
$$MS + 4H_2O \rightarrow MSO_4 + 4H_2\uparrow, \qquad \Delta > 0$$

where M=Ca, Sr, Ba, Mg and $\Delta \equiv \Delta W/W$, that is, the weight gain.

An important teaching of this study is that chemical stability in contact with water is closely associated with crystallinity of AES. The improved crystallinity and therefore chemical stability of S1 are believed to result from the unique reaction mechanism involved in the optimized method, which is discussed elsewhere[5].

**References**


1 Kaneko Y, Koda T. J Crystal Growth, 1988, 86(1):72~78

2 Jia Wei, Hou Xun. Acta Photonica Sinica, 1993, 22(2):121~125

3 Lindmayer J. Solid State Technology (USA), 1988, 8(2):195~197

4 Jia Wei. ACTA PHOTONICA SINICA, 1993, 22(1):91

5 Jia Wei. Ph. D. Thesis, XIOPM, 1993

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