Journal of Alloys and Compounds 699 (2017) 479–483

Contents lists available at ScienceDirect

Journal of Alloys and Compounds

journal homepage: http://www.elsevier.com/locate/jalcom

Ternary copper tungsten selenide nanosheets synthesized by a facile hot-injection method

Adem Sarilmaz, Mümin Can, Faruk Ozel*

Karamanoglu Mehmetbey University, Department of Metallurgical and Materials Engineering, 70200, Karaman, Turkey

ARTICLE INFO

Article history:
Received 19 October 2016
Received in revised form
22 December 2016
Accepted 29 December 2016
Available online 31 December 2016

Keywords:
Cu_2WSe_4
Hot-injection
Nanosheets
Nanostructure
Oleylamine

ABSTRACT

Transition metal chalcogenides are important materials due to their many useful properties. Here, for the first time, we have successfully synthesized *P*-Cu_2WSe_4 (CWSe) nanosheets by a simple and inexpensive hot-injection process. Morphology, structure composition and optical properties of the synthesized nanosheets were analyzed by XRD, TEM, AFM, EDX, FTIR and UV–Visible absorption characterization techniques. Characterization results show that the nanosheets were observed with good crystallinity and lacking of impurity. This work demonstrates that *P*-Cu_2WSe_4 nanostructures can be synthesized through a facile and simple hot-injection method. These results lead to the possibility of synthesizing a new generation of nanosheets with minimized reaction time and required pressure as alternative energy conversion materials.

1. Introduction

Ternary transition metal chalcogenides (Cu_2MX_4 (M=W, Mo; X=Se, S)) have drawn much attention because of their excellent absorption on visible-light region and suitable electro-optical properties, which provide efficient use to a lot of application areas like the energy storage, the photo-catalysis, the electronics industry, the hydrogen production, the solar cell technology and the light emitting devices [1–5]. Among the family of ternary metal chalcogenides, Cu_2WSe_4 is an alternative energy conversion material which has also the characteristics of semi-conductivity like other Cu_2MX_4 structured materials.

Up till now, there have been a few studies which have been carried out for the synthesis of the ternary tungsten-molybdenum (W-Mo) based on transition metal chalcogenides by a number of techniques such as hydrothermal [5,6] and solvothermal [7,8] methods. However, any primitive phase of ternary W-based hot-injection synthesis process has not been analyzed in literature so far. On the other hand, already defined routes require high pressure and/or long reaction time. For example, Pruss et al. reported the synthesis of Cu_2WS_4 under low temperature and ambient pressure conditions [9]. Li et al. synthesized Cu_2WS_4 by heating a sealed mixture in a stainless steel autoclave at 200 °C for 72 h [10]. Jing et al. used a facile hydrothermal method which has 200 °C and 72 h reaction conditions to synthesize decahedral Cu_2WS_4 [11]. Tran et al. showed that crystals of Cu_2MoS_4 can be synthesized via refluxing at 135 °C for 24 h [4]. Crossland et al. heated up the mixture of precursors between 110 and 220 °C during 6–96 h and obtained Cu_2MX_4 materials [7]. Chen et al. reported an eco-friendly route to obtain high quality of Cu_2MoS_4 nanomaterials in the *I*42m allotrope [8]. Liang and Guo used $CuCl_2$ and $[NH_4]_2MoS_4$ in ammonia solution and they produced Cu_2MoS_4 via a heating process in a hydrothermal autoclave [5].

Present study makes a considerable contribution to the production of Cu_2WSe_4 nanosheets through the hot injection method which is a facile, economic and quick route for the synthesis. Hot injection method helps shorten the reaction time and needed pressure, therefore this process enables to achieve saving vast amount of energy and time. The Cu_2WSe_4 nanosheets are obtained with just 30 min of reaction time and 300 °C reaction temperatures. This procedure is the quickest way to fabricate Cu_2WSe_4 up to the present in literature.

2. Experimental

2.1. Synthesis of colloidal Cu_2WSe_4 nanosheets

Nanostructured *P*-Cu_2WSe_4 was synthesized by using a

* Corresponding author.
E-mail address: farukozell@gmail.com (F. Ozel).

http://dx.doi.org/10.1016/j.jallcom.2016.12.401
0925-8388/

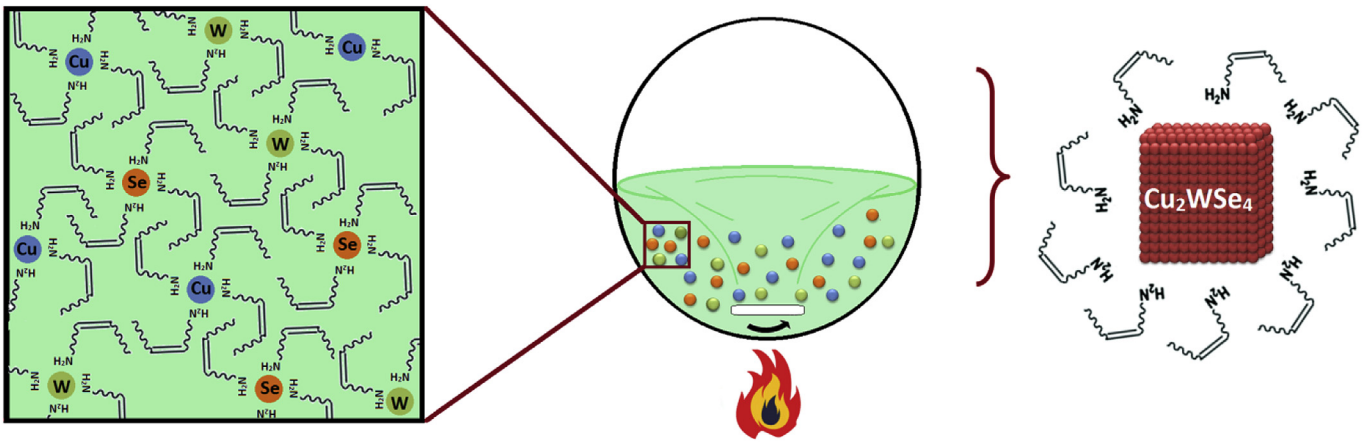
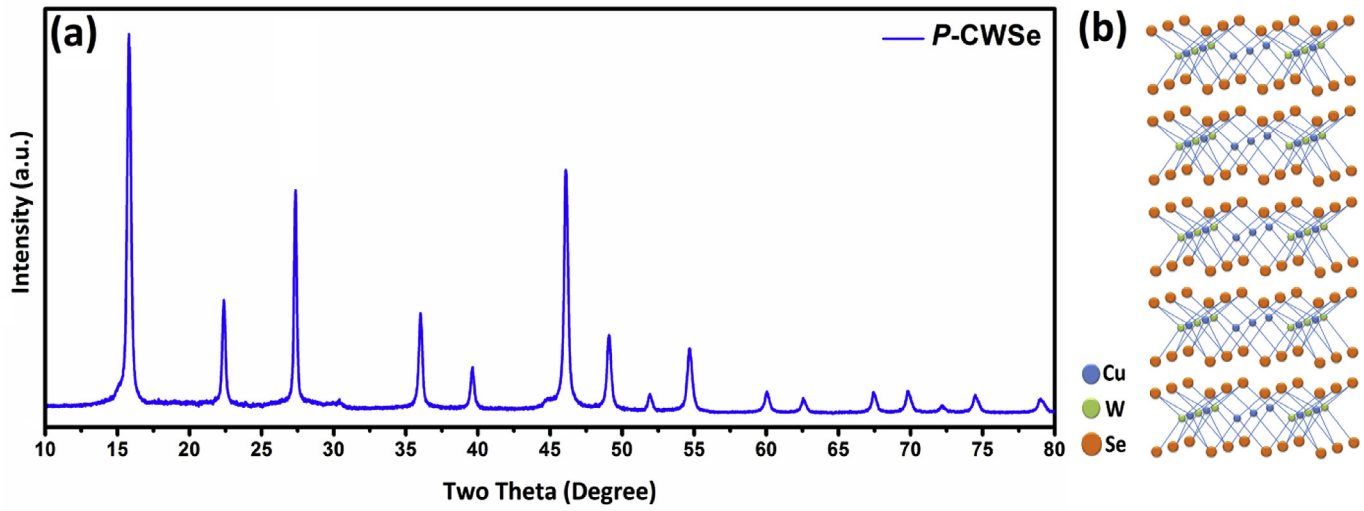


Fig. 1. Schematic presentation of the hot injection synthesis system of the Cu_2WSe_4.



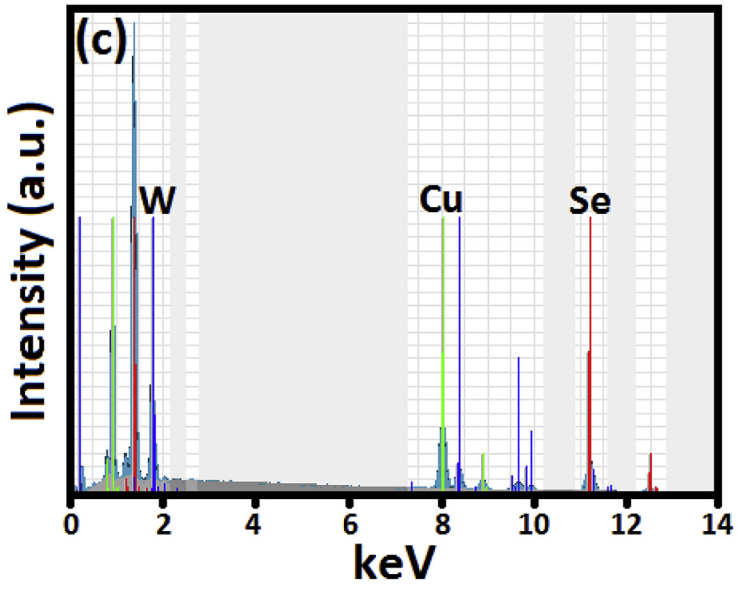


Fig. 2. XRD pattern (a), crystalline structure (b) and EDX spectrum of as-prepared Cu_2WSe_4 nanosheets (c).