

Назва: Growth and structure of thermally evaporated Bi<sub>2</sub>Te<sub>3</sub> thin films

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Ключові слова: bismuth telluride, thermal evaporation, glass substrates, polycrystalline thin films, grain size, crystal structure, crystal morphology, preferential orientation.  
телурид вісмуту, теплове випаровування, скляні підкладки, тонкі полікристалічні плівки, розмір зерна, кристалічна структура, морфологія кристалів

Дата публікації: 2016

Видавець: Elsevier

Бібліографічний опис: Growth and structure of thermally evaporated Bi<sub>2</sub>Te<sub>3</sub> thin films [Electronic resource] / E. I. Rogacheva [et al.] // Thin Solid Films. – Electronic text data. – 2016. – V. 612. – P.128-134.- URL :  
<https://www.sciencedirect.com/science/article/abs/pii/S0040609016302231>

DOI: doi.org/10.1016/j.tsf.2016.05.046

Реферат: The growth mechanism, microstructure, and crystal structure of the polycrystalline n-Bi<sub>2</sub>Te<sub>3</sub> thin films with thicknesses  $d = 15 - 350$  nm, prepared by thermal evaporation in vacuum onto glass substrates, were studied. Bismuth telluride with Te excess was used as the initial material for the thin film preparation. The thin film characterization was performed using X-ray diffraction, X-ray photoelectron spectroscopy, energy-dispersive X-ray spectroscopy, scan electron microscopy, and electron force microscopy. It was established that the chemical composition of the prepared films corresponded rather well to the starting material composition and the films did not contain any phases apart from Bi<sub>2</sub>Te<sub>3</sub>. It was shown that the grain size and the film roughness increased with increasing film thickness. The preferential growth direction changed from [001] to [015] under increasing  $d$ . The X-ray photoelectron spectroscopy studies showed that the thickness of the oxidized surface layer did not exceed 1.5 – 2.0 nm and practically did not change in the process of aging at room temperature, which is in agreement with the results reported earlier for single crystals. The obtained data show that using simple and inexpensive method of thermal evaporation in vacuum and appropriate technological parameters, one can grow n-Bi<sub>2</sub>Te<sub>3</sub> thin films of a sufficiently high quality.

Телурид вісмуту (Bi<sub>2</sub>Te<sub>3</sub>) є ефективним термоелектричним матеріалом, і виготовлення тонких плівок Bi<sub>2</sub>Te<sub>3</sub> з хорошими термоелектричними властивостями є необхідною умовою для реалізації потенціалу цих матеріалів у застосуванні мікропристроїв. Контрольоване осадження вмісту та термічна обробка з низьким негативним впливом є двома основними проблемами при виготовленні вискоелективних тонких плівок. У цьому дослідженні стехіометричний Bi<sub>2</sub>Te<sub>3</sub> тонкі плівки були успішно виготовлені за допомогою двоетапного процесу термічної пари з одним джерелом

випаровування. Потім швидкий термічний процес, який міг уникнути втрати компонентів, був використаний для подальшого покращення кристалічності та термоелектричних властивостей тонких плівок. Коефіцієнт Зеєбека тонких плівок  $\text{Bi}_2\text{Te}_3$  явно збільшився після швидкої термічної обробки, що призвело до підвищення коефіцієнта потужності та хорошої гнучкості. Такі тонкі плівки демонстрували низьку теплопровідність через їх нанорозмірні зерна, що призвело до високого ZT гнучких тонких плівок  $\text{Bi}_2\text{Te}_3$ .

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