Ultrafast and Broadband Photodetection Based on Selenized AgSbS2 Thin Films Prepared by Spray Pyrolysis Deposition and Modified by Indium Nitrate

Zhen Zhang¹, Jiang Cheng¹, Xin Yang², Dongyu Bai¹, Hua Tang¹, Xihao Chen¹, Xiang Meng¹, Genglong Chen¹, Shenghao Wang³, and Lu Li¹

¹Chongqing University of Arts and Sciences
²Shandong University of Science and Technology
³Shanghai University Materials Genome Institute

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Abstract

Miangyrite silver antimony chalcogenide (AgSbS2) exhibits a promising photoresponse to sunlight. However, the large band gap (~1.7 eV) limits its practical application, especially in 1300-1550 nm range require for laser communication. Although selenization can reduce the band gap of AgSbS2 film, the effectiveness is hindered by the compact crystal grain structure, resulting in limited selenization only at the top surface and an insufficient selenization rate. In this work, we prepare a gradient structure AgSbS2(Se) film through spray pyrolysis with a post selenization. To achieve a high selenization rate, we construct a loose AgSbS2 precursor via innovatively adding some indium nitrate to the spray solution. By optimizing the process, we successfully fabricated broadband photodetectors with a response range extending beyond 1920 nm. The fabricated photodetectors not only exhibit excellent broadband response characteristics but also demonstrate a high bandwidth of up to 0.3 MHz and a rapid response time of 1.12 μs. These outstanding features indicate great potential for application in high-speed photon computation and communication systems. This novel gradient structure AgSbS2(Se) film opens up new possibilities for developing high-performance broadband photodetectors essential for advancing laser communication technology.

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