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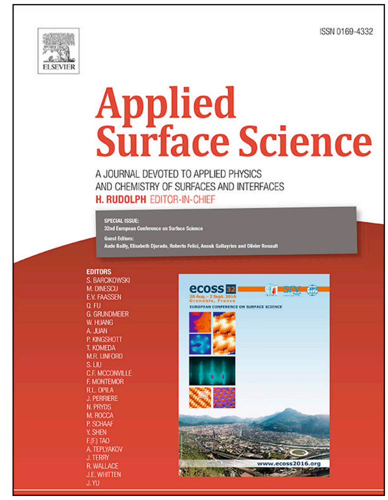

Full Length Article

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Defect-induced room-temperature visible light luminescence in Mg_2Si:Al films

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Abstract: The Al-doped Mg_2Si thin films were fabricated on sapphire substrates by magnetron sputtering technique, and the influences of different Al doping contents on the Raman scattering and room-temperature (RT) photoluminescence (PL) of Mg_2Si thin films were investigated. The crystal structure, morphology, composition, Raman scattering and PL property of the thin film were examined using X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM) equipped with energy dispersive X-ray spectroscopy (EDS) and Raman spectroscopy, respectively. XRD results indicate that the intensity of diffraction peaks of Al-doped Mg_2Si thin films are higher than that of undoped Mg_2Si thin film, and decrease with increasing Al doping content. The FESEM image shows a few cavities in the surface of the film. The EDS results show that the thin films have the Al content of 0, (1.17±0.1) at.%, (1.53±0.1) at.%, (1.86±0.08) at.% and (2.76±0.11) at.%, respectively. The results of Raman scattering measurement reveal that all samples have the characteristic peak of Mg_2Si. And Al dopant-induced Raman peak centered at 441 cm^{-1} was detected. Room-temperature photoluminescence of the Mg_2Si:Al film was observed for the first time. Two visible light luminescence peaks center about 580 nm (2.14 eV) and 630 nm (1.97 eV), respectively, which originate from the different energy levels transition at the interface between crystalline Mg_2Si and MgO surface layer. With decreasing excitation power, the position of the maximum of PL has no obvious change and the intensity drops significantly.

Keywords: Mg_2Si base thin films; Al doping; Raman spectra; RT-photoluminescence

1. Introduction

Many efforts have been made to modulate the band gap emission or improve luminescent efficiencies of low-dimensional semiconductors including thin films and nanoparticles in the recent decade [1-5]. Photoluminescence of semiconductors has different origins from band edge luminescence and (intrinsic or doping) defect -related luminescence. Almost defect-free quantum dots are often obtained at high temperature to realize band edge luminescence with high efficiency [4]. On the other hand, films obtained at room-temperature or low-temperature give rise to photoluminescence ascribing intrinsic defect levels in the band gap. Implanting exotic atoms in the host, it is also possible to produce

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