# Photoresponse property of $BaSi_2$ film grown on Si substrate by vacuum evaporation

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We have succeeded in observation of photoresponsivity of $BaSi_2$ film grown on Si by vacuum evaporation method, raising its promising application in high efficiency thin film solar cell. Photocurrent was observed at photon energies larger than 1.28 eV which is corresponding to band gap of evaporated $BaSi_2$ film.

Orthorhombic $BaSi_2$ has emerged as a promising candidate for thin film solar cell with many great advantages such as abundant elements, ideal band gap and high absorption coefficient [1-4]. High-quality epitaxial $BaSi_2$ film has been grown on Si by molecular beam epitaxy (MBE) [1, 2]. The potential properties of the film in application to thin film solar cell has been explored [3]. However, MBE method needs high vacuum and has low deposition rate. It would not be suitable for practical application. Vacuum evaporation (VE) is one promising method for growing $BaSi_2$ film. This method has high deposition rate and can apply for large-scale substrate area. It has been reported by Nakagawa *et. al* that single phase polycrystalline $BaSi_2$ was successfully grown on Si by using VE [3]. However, there is no report of photoresponsivity for $BaSi_2$ film grown on Si by VE method. This study is the first report of photoresponsivity of $BaSi_2$ film grown on Si by VE, demonstrating the possibility of the film for high-efficiency thin film solar cell application.

We have grown 0.9 μm-thick-$BaSi_2$ on p-type Si (111) substrate at a substrate temperature of 500 $^{o}$C. By Hall effect measurement using Van der Pauw method, we confirmed that un-doped evaporated $BaSi_2$ is n-type and has sheet carrier density of $1.3\times10^{15}$ $cm^{-2}$. Effective carrier lifetime ($\tau_{1/e}$) of the film is 0.46 μs. ITO/$BaSi_2$/Si/Al structure was used for photoresponse measurement shown in Fig. 1. We employed lock-in technique using a 450 W xenon lamp with a monochromator to produce monochromatic light with a stable power of 50 μW/$cm^2$ for this measurement. Figure 2 shows photoresponsivity spectra for ITO/$BaSi_2$/p-type Si/Al under reverse voltage. The onset of photocurrent is at 1.28 eV which is corresponding to band-gap of evaporated $BaSi_2$ film [4]. High crystallinity and lifetime are considered as the main factors contributing to photocurrent. The result obtained indicates that evaporated $BaSi_2$ film has potential for thin film solar cell application.

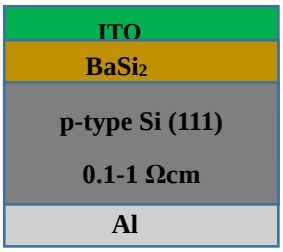


Figure 1. Structure of sample for photoresponsivity measurement.

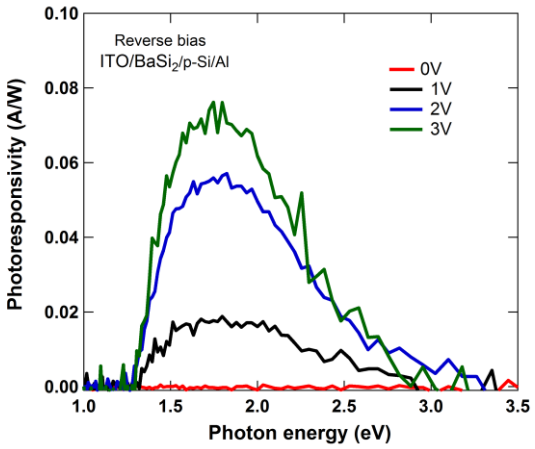


Figure 2. Photoresponse spectra for ITO/$BaSi_2$/p-type Si/Al under reverse voltage.

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***References***

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