Abstract

CZTSSe has big potential in thin film solar cell, its all made from earth abundant element, those can reduce the cost. The best cell performance of CZTSSe is demonstrated by IBM, so far can reach 12.6%. Although IBM use solution process to fabricate CZTSSe thin film solar cell, which should have potential for large scale fabrication, but hydrazine, the solvent they used is highly toxic and explosive. Many research group start to develop solution process that is suited for large scale fabrication, nanoparticles process, one of the method can reach cell efficiency 9.6% so far. But traditional nanoparticle synthesis used long hydrocarbon chain compound as surfactant to stablize nanoparticles, and those organic compound may residual in device therefor reduce cell performance. In this research, we refer to the idea that using metal chalcogenide complex $Sn_2S_6^{4-}$ as surfactant to design a new ink for CZTSSe. $Sn_2S_6^{4-}$ can replace long hydrocarbon chain compound, and provide Tin we need. We start from synthesising the nanoparticles, then probe into the influence on $Sn_2S_6^{4-}$ to ink stability. We also analysis the residual of by-products after heat treatment. In the final, we fabricate thin film by coating our ink on substrate and analysis the film quality. The best cell performance we can reach so far is 0.7%.

摘要

CZTSSe太陽能電池是目前所有薄膜太陽能電池中非常具有潛力的太陽能電池之一。CZTSSe所有的材料都是地球上所富含的元素，可以把成本壓到非常低。目前最高效率的CZTSSe是由IBM所發表的12.6 %。雖然IBM使用的是溶液法的聯胺製程，然而聯胺是一種具有很強的毒性及危險性的溶劑，所以無法應用到工業量產上面。因此許多團隊開始發展能夠量產的溶液製程，其中奈米粒子的製程技術製作出來的CZTSSe元件最高可達9.6 %。但由於一般的奈米粒子合成都會使用長碳鏈的分散劑來穩定奈米粒子，而這些有機化合物容易殘留在薄膜內部影響元件效率。在本論文中，我們引用了以金屬硫化物錯合物$Sn_2S_6^{4-}$做為分散劑的概念，開發一種新的前驅漿料設計。一方面是避免碳鏈分散劑的使用，另一方面也用來提供CZTSSe所需要的錫。我們從奈米粒子的合成開始，探討$Sn_2S_6^{4-}$對於漿料穩定度的影響，接著我們分析漿料中的雜質在熱處理後的殘留情況。最後我們將漿料塗布成薄膜，並且分析薄膜的品質以及示範了元件轉換效率，目前本製成技術可以達到最高的原件轉換效率為0.7 %。