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Research on the Optical-Electrical Characteristic of Amorphous Silicon Thin Film

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Amorphous silicon thin film solar cells have excellent photoelectric properties including simple preparation process, low production cost, easy to manufacture in large area. In this paper, we studied the influence of each layer parameters on performance of a-Si solar cells by wxAMPS simulation software such as the thickness, optical band gap, the doping concentration of the window layer and the defect density of intrinsic layer on the solar cells. Results show that when the thickness of the window layer increases from 5nm to 30nm, the conversion efficiency of solar cell decreases, and the conversion efficiency improves when the optical band gap of the window layer increases from 1.6eV to 1.9eV. The doping concentration in window layer and the defect density in the intrinsic absorption layer are the key factors that influence the performance of solar cell, the performance deteriorate rapidly when the doping concentration in window layer is lower than 10^{19} cm^{-3} , or the defect density of intrinsic absorption is higher than $10^{17} \text{ cm}^{-3} \text{ eV}^{-1}$. The best performance of solar cell is obtained with the conversion efficiency of 7.82% when the thickness of the window layer is 5nm. Considering much defect in thin film in actual production in factories if the thickness of window layers is too thin, we choose 10nm as the optimal value with the conversion efficiency of 7.55%. The optimal value of optical band gap of window layer is 1.9eV. Though the band gap of a-Si thin film is about 1.72eV, we can increase it by other processions, such as the incorporation of Ge and C element in window layer. The theoretical study on various factors on the open-circuit voltage (Voc), short-circuit current (Joc), fill factor (FF) and the conversion efficiency of solar cells will provide theoretical guidance to experiment and production.

Author: Ms HUANG, Aiqing

Co-authors: Prof. ZHU, Tong; Prof. LIU, Kun (1 School of Mechanical Engineering and Automation, Northeastern University, Shenyang, China, 110004; 2 Key Laboratory of Vibration and Control of Aero-Propulsion Systems Ministry of Education of China, Northeastern University, Shenyang, 110819, Liaoning, China); Mr CHEN, Shulei; Mr BA, Yaoshuai; Prof. BA, Dechun; Prof. XIE, Yuanhua

Presenter: Prof. LIU, Kun (1 School of Mechanical Engineering and Automation, Northeastern University, Shenyang, China, 110004; 2 Key Laboratory of Vibration and Control of Aero-Propulsion Systems Ministry of Education of China, Northeastern University, Shenyang, 110819, Liaoning, China)

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