The Influence Of Boron And Phosphorus Content By Multi-Fluxes Addition In Metallurgical Grade Silicon

林士敬、廖芳俊

E-mail: 364848@mail.dyu.edu.tw

ABSTRACT

The focal points of this solar-grade poly-silicon refinement study are following the directions of reduction of cost, pollution, and energy consumption. Therefore, this research adopted the process of oxide fluxes with low cost and low pollution to eliminate the impurities from metallurgical grade silicon. In here, various types of multi-fluxes with different adding quantity were designed. Then, process with vacuum melting and directional solidification, after that silicon ingots were sliced to analyze the content of impurities. Therefore, we can figure out the relations between types, relative ingredient, and adding quantity of multi-fluxes with impurities removal in metallurgical grade silicon. Experimental results shown that the implementation of vacuum melting and directional solidification processes indeed improve the purity of silicon. Although the removal of Boron was not so outstanding, the effectiveness of element elimination, such as Iron and Phosphorus were superior. By cross-examining the results of 9 combinations of multi-fluxes found that silicon dioxide plays an important role in poly-silicon refinement, and adding small amount of calcium oxide and alumina can further facilitate the removal of impurities with their high oxygen affinity nature. We also find that, with little amount of sodium bicarbonate addition, the viscosity of liquefaction silicon can be reduced and improved the fluidity to assist impurities float. Therefore, researcher suggested that the best combination of multi-fluxes to purify the metallurgical grade silicon is 8SiO2-1CaO-1Al2O3, and with 10 wt.% addition. For Iron content can be reduced from 190 ppm. to 7 ppm. with almost 96% removal rate. As for the Phosphorous content, it can be reduced from 9 ppm. to zero, leading to 100% removal rate. Although this flux has shown limited effectiveness in Boron removal, it still reached a removal rate of around 10%.

Keywords : Metallurgical Grade Silicon、Multi-Fluxes、Directional Solidification、Refining

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