The Effect of Fluxes to Metallurgical Grade Silicon Impurities Removal

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ABSTRACT

According to the rapid growth of photovoltaic industry, the demand for 6N poly-silicon feedstock has been greatly increased. Even though the chemical refining approach of Siemens process is capable of producing silicon material with 9N purity, this process consumes a huge amount of energy with low production volume and high manufacturing cost. Also, the hazardous wastes generated during the production process will cause severe damage to the environment, thus its future use will be affected. The purpose of this study is to investigate and analyze how the variety and addition quantity of fluxes are going to affect the removal of all kinds of impurities within the metallurgical grade silicon. The fluxes we selected include CaO, Al2O3, and SiO2 with high oxygen affinity, Ba(OH)2 with high capability of removing metal element, and NaHCO3 which is effectively reducing the viscosity of silicon melt. In this research we plan to use fluxes with single-constitute or multi-fluxes with certain content ratio, such that we can investigate the distribution and variation situations of impurities within solidified silicon ingots by changing the variety and addition quantity of fluxes. The experimental results show that the use of single-constitute fluxes can be effective in the removal of Iron (Fe) and Phosphorous (P) impurities in metallurgical grade silicon powder, expect for Al2O3, which has a rather insignificant effect in removing P. The addition quantity should not be too much, where the 2 wt.% is optimal. There is no significant effect in removal of Boron (B). As for multi-fluxes, if we take the CaO and SiO2 with proper ratio and mix with a small dose of NaHCO3, it will have significant effectiveness in removal of Fe and P impurities. After the analysis on overall refining results, the suggested choice of multi-fluxes is the mixture of NaHCO3, CaO, and SiO2 with a ratio of 1：3：6, and an addition quantity of 2~5 wt.% for the best impurity removal results.

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

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