한국신·재생에너지학회 2007년도 추계학술대회논문집 pp.268

대형 다결정 실리콘 성장을 위한 ADS 법의 기하학적 매개변수 변화에 따른 열유동 공정모사

서 중원[1], 황 정훈[2], 김 윤제[2], 문 상진[3], 소 원욱[3], 김 민순[4], 길 종원[4], 윤 대호[1]

Numerical simulation of heat transfer by the change of geometric parameters in ADS method for large sized polycrystalline silicon growth

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Key words : silicon ingot(실리콘 주괴), photovoltaic industry(광발전 산업), polycrystalline(다결정), advanced directional solidification(진보된 방향성 응고), numerical simulation(수치적 공정모사), geometric parameters(기하학적 매개변수)

Abstract : The further development of the manufacturing processes of solar silicon (Si) ingot is one of the more important issues to guarantee the growth of the photovoltaic (PV) industry. The reason why is the saving of manufacturing costs of ingots, wafers, solar cells and of solar modules. In recent PV market, polycrystalline Si wafers have played a major role to fabricate solar cells due to the cost effectiveness. Several solidification processes have been developed by industry including casting, heat exchanger method (HEM) and electromagnetic casting. However, the market growth using Si wafers might be saturated due the shortage of Si feedback. Therefore, two of the main targets of the PV industry today are to increase the ingot weight and to accelerate the growing rate of polycrystalline solar ingots.

Consequently, in this study, the advanced directional solidification (ADS) method is used to the satisfaction of above-mentioned main targets. The ADS method has the advantages of the small heat loss, short cycle time and efficient directional solidification. Based on the fluid dynamics model, the numerical simulation was performed on the thermal characteristics during the ADS process. The heat transfer characteristics in the ADS process are calculated by using a commercial CFD code, Fluent. The temperature distributions are simulated by geometric parameters variation of heat exchanger.

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