

MELTING AND PROCESSING OF SILICON BY MICROWAVE HEATING

T. Gerdes*^{1,2}, H.S. Park^{1,3}, I. Sen¹, M. Willert-Porada¹

¹University of Bayreuth, Chair of Materials Processing; ²Invertec e.V., ³Center of New Materials Bayreuth GmbH, Bayreuth, Germany

ABSTRACT

Microwave heating is applied for processing different silicon raw materials, based on the size-, shape- and composition-dependent absorption of radiation of 2.45 and 916 MHz frequency by silicon. In model experiments directed towards the improvement of melting technology, Si-fines and chunks of bulk Silicon from Electronic Grade (EG)- and Solar Grade (SG)-silicon production are used as raw materials. The penetration depth of microwave radiation into Si-powder beds is calculated and experimentally verified as a function of the void space of the powder bed as well as taking into account the electrical conductivity of the different silicon grades.

Based on these starting materials with a defined level of impurity and a strongly varying electrical conductivity, different microwave heating schedules are investigated and a hybrid resistance + microwave heating processing concept for melting silicon as well as for the control of the wetting behavior of silicon melts towards different ceramic crucibles is developed.

The silicon melts are processed to yield different products:

- Granular silicon applied in the production process of SG-silicon wafers
- New ceramic materials from Si-infiltrated ceramic composites

In case of the granular silicon production, microwave heating to melt the silicon fines is beneficial in terms of melt purity and reduced melt-crucible reactions [1]. Furthermore, Silicon fines difficult to melt by other methods can be recycled and used in silicon production.

For the development of new materials, microwave heating of fine silicon powders enables infiltration of porous ceramics usually not being wetted by Si-melts, to yield after final nitridation high temperature stable, binder free ceramics [2].

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REFERENCES

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