Karlsruher Institut für Technologie

Institute of Mechanical Process Engineering and Mechanics
Applied Mechanics Group
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Bachelor thesis
For Cand. B. Sc. XXXX

Rheological characterization and formulation of high temperature silver pastes for front side metallization of silicon solar cells

No.: XXXX

In the context of the increasingly important generation of electrical energy from renewable sources, the importance of solar power generation with silicon solar cells is steadily increasing. In order to conduct the generated electrical energy, these cells are contacted with silver, which is applied as a paste at high production speeds by screen printing. In a subsequent drying and sintering process, the solvents are removed from the printed conductor track and contact is made with the underlying cell.

In this process, highly filled silver pastes are formulated close to the maximum particle packing fraction due to the high conductivity requirements. The weight fraction of solids in the paste is about 90%. In order to nevertheless be able to set the printability of the pastes with the desired line homogeneity as well as a high aspect ratio, the rheological properties of the paste are decisive and must be precisely investigated and adjusted. These properties are achieved by formulating the so-called vehicle system, a mixture of different solvents and rheological agents. The rheological agents can be polymeric additives (thickeners and thixotropic agents) and surfactants, but also physical concepts such as the capillary suspension concept.

In the bachelor thesis, a series of pastes with different particle volume fractions and surface morphologies will be extensively characterized rheologically. The rheological characterization includes the determination of the yield stress with a vane- as well as a plate-plate geometry on the rotational rheometer, and the determination of the viscosity at high shear rates with the capillary rheometer. The slip velocity below the yield point is determined with smooth plates on the rotational rheometer and under shear conditions relevant to the printing process with a capillary viscosimeter specially designed for this purpose. The fracture strain is determined in uniaxial stretching. The experiments on the rotational rheometer will also be documented with a video camera and the true deformation will be observed and evaluated.
In addition, pastes based on an alternative vehicle with similar solvents but a different thixotropic agent will be formulated with the particles used above. These pastes will also be characterized with respect to the rheological parameters mentioned above.

Finally, the results are to be presented in the form of a written thesis as well as in an ungraded seminar presentation.

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Start: At any time
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