Solar Cell Efficiency in Relation to Composition and Concentration of Glass Frits in Front Side Silver Pastes

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Various silver pastes of different glass frit compositions and concentrations were prepared in this study to determine the effect of glass frits in front-side pastes on solar cell efficiency. The results first showed the absolute necessity of the glass frit in making front-side silver pastes. It is demonstrated that the inclusion of PbO and TeO2 in glass frits is important in developing silver pastes for high solar cell efficiency. Use of (PbO+TeO2)-containing glass frit in the silver paste yields a multi-crystalline silicon cell efficiency of 17.3% while the PbO-containing glass frit resulted in a cell efficiency of only 10.3%. Moreover, replacing PbO- containing glass frit with Bi2O3- containing glass frit yielded extremely low efficiencies (0.92%). This study further demonstrated that there existed a best (PbO+TeO2)- glass frit concentration at 2.5 wt% which led to the highest solar cell efficiency in this study. As the glass concentration of pastes increased and approached 2.5 wt%, their resulting cells became more efficient. As the glass concentration of pastes further increased beyond 2.5 wt%, their resulting efficiencies decreased. The underlying mechanism behind glass-silver and glass-silicon interactions and their relation to the resulting cell efficiencies is discussed with the aim of developing novel, more efficient silver pastes.

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