Siemens Competition
Math : Science : Technology
Regional Finalist

Name: Walter Li
High School: Canterbury School
Mentor: Dr. Panjian Li
Project Title: *Solar Cell Efficiency in Relation to Composition and Concentration of Glass Frits in Front-Side Silver Pastes* (Chemistry; Materials Science/Nanoscience)

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-containing glass frit yielded a multi-crystalline silicon cell efficiency of 10.3%, whereas using Bi2O3-containing glass frit yielded extremely low efficiencies of 0.92%. The presence of TeO2 in glass frit in the silver paste yields a cell efficiency of 16.96%, significantly higher 10.3% efficiency without TeO2. 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. The underlying mechanisms behind glass-silver and glass-phosphorus doped silicon interactions during front side solar cell metallization, and their relation to the resulting cell efficiencies, are discussed. In particular, the apparent importance of tellurium and silver oxides will be proposed, with the aim of developing novel, more efficient silver pastes in the future.