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Temperature-Dependent Electron Transport in Si and Ge Nanoparticle Photovoltaics DEREK PADILLA, CARENA CHURCH, University of California, Santa Cruz, ELAYARAJA MUTHUSWAMY, SUSAN KAUZLARICH, University of California, Davis, SUE CARTER, University of California, Santa Cruz — We have studied both Si and Ge nanoparticle-based photovoltaic (PV) devices fabricated in a layered structure via spin-coating of the colloidal Si or Ge solution. With the low toxicity and high abundance of these group IV elements, combined with the relatively low costs of manufacturing via solution deposition, large-scale device processing offers high dollar-per-Watt opportunities as efficiencies continue to improve. To that end, we previously reported temperature effects of solution-processed PbS quantum dot (QD) PVs, wherein the capping ligand's thermal properties were shown to have strong effects on device performance. Here we show similar ligand effects in group IV QD devices. Current-voltage (I-V) measurements at temperatures from 100 to 360 K under dark conditions were fit to the ideal diode equation revealing the electron transport mechanism, with fit parameters matching transport models. The illuminated I-V data provide insight into each device's built-in potential, carrier mobility, and activation energy. In addition, modulating the illumination intensity gives the ideality factors of the solar cells. We show how these variations with temperature and light-intensity can be used to increase device performance for future studies.

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