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Origins of varying carrier concentration in Cu_2SnS_3 photovoltaic absorbers LAURYN BARANOWSKI, Colorado School of Mines, National Renewable Energy Laboratory, PAWEL ZAWADZKI, STEPHAN LANY, WILLIAM TUMAS, DAVID GINLEY, National Renewable Energy Laboratory, ERIC TOBERER, Colorado School of Mines, National Renewable Energy Laboratory, ANDRIY ZAKUTAYEV, National Renewable Energy Laboratory — Within the Cu-Sn-S family of earth abundant photovoltaic absorbers, the Cu_2SnS_3 phase is predicted to be the most promising absorber material [P. Zawadzki, et al.]. To date there has been limited synthetic work on the Cu_2SnS_3 phase, particularly the carrier concentration. In this study, we develop an understanding of the effects of RF sputtering growth conditions on the hole concentrations of Cu_2SnS_3 absorber films, and use these results to identify the underlying causes of the observed variations in carrier concentration. Two effects are identified that control the carrier concentration in Cu_2SnS_3 films. The first effect, which occurs during Cu-rich growth, is isostructural alloying with a metallic Cu_3SnS_4 phase, which gives rise to hole concentrations above 10^{19} cm^{-3}. The second effect is that, when the Cu_2SnS_3 films are grown under Sn-rich conditions, varying the S chemical potential during film deposition gives 10^{18}-10^{19} cm^{-3} holes. This variation in carrier concentration with S chemical potential can be explained by a Cu vacancy defect model. Understanding the origins of the varying doping density in Cu_2SnS_3 films allows for targeted growth to achieve desired carrier concentrations for device integration.

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