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Materials characterization and optimization in silicon heterojunction solar cells using spectroscopic ellipsometry DEAN LEVI, EUGENE IWANICZKO, QI WANG, HOWARD BRANZ, National Renewable Energy Laboratory — Silicon heterojunction solar cells (SHJ) utilize very thin (3-5 nm) layers of amorphous silicon deposited on the surface of crystal silicon to produce very high efficiency solar cells with low temperature processing. Our research team has used hot wire chemical vapor deposition (HWCVD) to fabricate SHJ solar cells on p-type FZ silicon with efficiencies as high as 18.2%. The best cells are deposited on textured (100) silicon substrates where the texturing process creates pyramidal facets with (111) crystal faces. One of the key factors in maximizing the efficiency of our SHJ devices is the process of optimizing the material properties of the amorphous silicon (a-Si) layers used to create the junction and back contact in these cells. Such optimization is technically challenging because of the difficulty in measuring the properties of extremely thin layers. This difficulty is compounded by the fact that the properties of such amorphous layers are substrate- and thickness-dependent. We report in this study how the substrate temperature and substrate orientation affect the structural, optical, and electronic properties of the a-Si layers used in our SHJ devices, and how these properties affect the final device performance.

Dean Levi
National Renewable Energy Laboratory

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