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Breakdown physics of low-temperature silicon epitaxy[1] CHARLES W. TEPLIN, PAULS STRADINS, EUGENE IWANICZKO, QI WANG, KIM M. JONES, ROBERT REEDY, BOBBY TO, DEAN H. LEVI, HELIO MOUTINHO, HOWARD M. BRANZ, National Renewable Energy Lab — We describe new insights into the mechanisms that affect low-temperature silicon epitaxy growth (T$<$630°C) by chemical vapor deposition (CVD). Experiments using hot-wire CVD show that below 500°C epitaxial growth is limited to relatively small thicknesses ($\sim$0.5μm), after which an amorphous nucleates and takes over film growth. Above $\sim$600°C, however, epitaxy is possible to very large thicknesses (at least 11 μm) and no breakdown is observed. We present an isotropic model for growth that explains the morphologies observed after breakdown to a-Si:H at low temperatures. The cause of breakdown, however, is still not well understood. However, our hot-wire CVD experiments over a large range of temperatures (200-700°C) provide important insights into the roles of roughness (that is implicated in the failure of low-T molecular beam silicon epitaxy) and hydrogen in epitaxy failure.

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Charles Teplin
National Renewable Energy Lab

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