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High Temperature Optical Properties of Semiconductors for Thermophotovoltaics CHLOE DOIRON, GURURAJ NAIK, Department of Electrical and Computer Engineering, Rice University — According to the US Department of Energy, the US industrial sector generates over 1.5 PWh of unrecovered waste heat each year. A significant portion of this waste heat is at reservoir temperatures below 900K. Thermophotovoltaics (TPV) has the potential to capture waste heat for electricity generation. Previous work focused on TPV applications with emitter temperatures greater than 1000K. For low temperature TPV applications, emitters fabricated from semiconductors are exciting because of lower losses, tunable optical properties including losses, and ease of fabrication. However, optical constants of semiconductors are not measured at high temperatures. We will demonstrate methods to predict the optical properties of semiconductors at high temperatures. Using these models, we will discuss the role that optical loss plays in designing efficient thermal emitters. Additionally, the physical models elucidate material properties and carrier physics to consider when selecting the ideal semiconductor for a specific emitter temperature. We will compare semiconductors with metals showing that lossy dielectrics can have significant advantages. With this knowledge, we designed and simulated nanophotonic thermal emitters capable of achieving high TPV efficiencies at temperatures below 900K.

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