Kolloquium Energie- und Halbleiterforschung

Universität Oldenburg
Institut für Physik
Abteilung Energie- und
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Increasing and understanding energy yield of c-Si PV modules

A holistic energy yield evaluation approach was developed. The optical, thermal and electrical behavior of PV modules was integrated into the modelling approach to be able to perform an energy loss analyses and short- and long-term energy yield calculations as a function of ambient conditions (temperature, wind and irradiance). This bottom-up model consists of a thermal and electrical equivalent sub-circuit. The thermal equivalent circuit incorporates the conduction, convection and radiation of heat within and from the PV module. Finite element modelling (FEM) computational fluid dynamics (CFD) models and wind tunnel tests were used to calibrate the thermal model, both for spatial and temporal effects. Thermal capacitance and resistance values were extracted from measurement and FEM models and the full thermal model was validate by indoor and outdoor measurements. The 1-diode model was used for the electrical circuit of the cell. The parameters of the electrical model were extracted from flash and steady-state I-V measurements. The thermal sub-circuit was used to calculate the temperature of each cell in the module, and this temperature is then further used to calculate the electrical characteristics of every individual cell. The result was successfully compared to outdoor measurements, proving that the model can be used for energy yield evaluation. Due to the physics-based nature, the approach can be used for the energy yield exploration of novel PV module technologies including smart PV modules.