Kolloquium Energie- und Halbleiterforschung

Universität Oldenburg
Institut für Physik
Abteilung Energie- und
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Dienstag, 13.06.2017, 16.15 Uhr in W0 0-001

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EHF - LCP

Modeling and simulation of recombination dynamics in Cu(In,Ga)Se_2 thin film solar cells

Time resolved photoluminescence (TRPL) is a contactless and nondestructive method of investigating charge carrier lifetimes in Cu(In,Ga)Se_2 thin film solar cells. It is relevant to have a clear analysis of the mechanisms dominating the charge carrier lifetime, since they are expected to also be the limiting factors on solar cell efficiency. This would be an important information about which steps of production should be improved. Therefore, TRPL is a promising tool to assess material quality during intermediate production steps. The interpretation of such results however, is not always clear, since many mechanisms can simultaneously have an effect on the measured lifetime of charge carriers. Simulations of TRPL decay curves can help interpreting experimental results by verifying the models regarding the lifetime of electrons in the studied solar cells. During this PhD work a model for Cu(In,Ga)Se2 thin film solar cells capable of accurately simulating results from TRPL and current-voltage measurements (IV) as well as quantum efficiency spectra (EQE) has been developed. This model takes into account radiative as well as non-radiative recombination but also the trapping of electrons into shallow defect states and the emission of such trapped electrons back into the conduction band. This model is then used to discuss to which extent TRPL measurements can be effectively used to make predictions about solar cell efficiency.