Highlights

Other Materials - 2016

A noise model for the evaluation of defect states in solar cells

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A theoretical model, combining trapping/detrapping and recombination mechanisms, is formulated to explain the origin of random current fluctuations in solar cells. The applicability of the proposed model has been verified on pristine and artificially degraded silicon-based devices. Distinct differences between dark and photo-induced noise have been found and interpreted in terms of a Shockley-Read-Hall theory. The reported results show that the formation of the defects, activated under illumination or charge carrier injection, is related to long-term degradation of the solar cells.

Noise analysis can also provide interesting information on radiation damage, and can be used for a detailed temperature-dependent electrical characterization of the charge carrier capture/emission and recombination kinetics. This aspect represents an advantage of the fluctuation spectroscopic technique, which gives the possibility to directly evaluate the cell health state.

Application of this noise model to other photovoltaic materials, such as organic and perovskite compounds, is currently in progress.

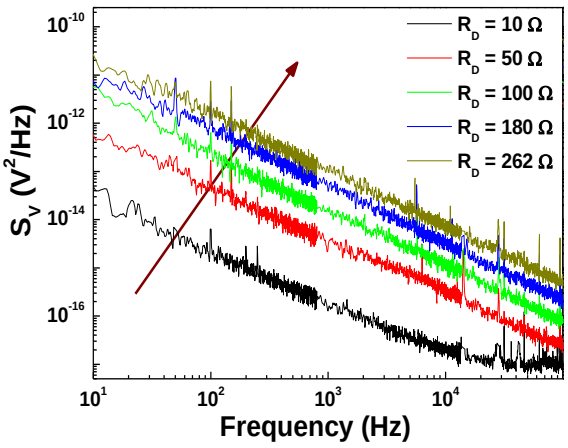

Figure 1. Frequency dependence of the voltage-spectral density S_V, at 300 K and for several differential resistance R_D values. A similar behavior is observed for pristine and proton irradiated silicon solar cells.

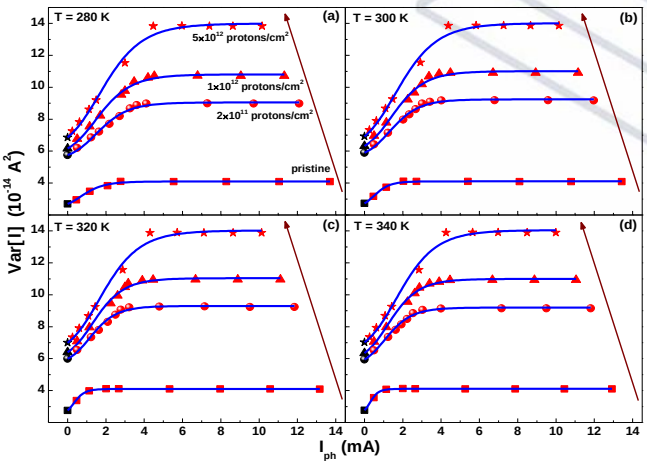

Figure 2. Dependence of the current fluctuations amplitude on the photocurrent for temperatures from 280 to 340 K. The experimental data points and the best fitting curves, using the formulated model, are shown for pristine and irradiated samples.