Increasing temporal resolution for in-situ MPL measurements

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Abstract

Solar cells are a promising and important technology part of humanity's future energy sustainability. To further develop and increase solar cell efficiency, the underlying changes which occur during fabrication become an increasingly important factor requiring in-situ characterization. An important parameter is the effective minority carrier lifetime in the absorber material which characterizes device performance towards achieving higher efficiency solar cells.

Modulated photoluminescence (MPL) allows for quantitative contactless measurements of minority carrier lifetimes via laser intensity-modulation sample excitation. This technique allows measurements of both finished and partially fabricated solar cells.[1] In-situ MPL takes advantage of these properties enabling measurements during fabrication.[2] To further develop this characterization method increasing the temporal resolution is required, as actual lifetime requires multiple differential lifetime measurements taking ~8 seconds each. Therefore, a decrease in total acquisition time to increase accuracy and fully define a differential carrier lifetime curve is required. We discuss the method of improvement through signal acquisition and data processing with a target acquisition period of the order of 1 second.

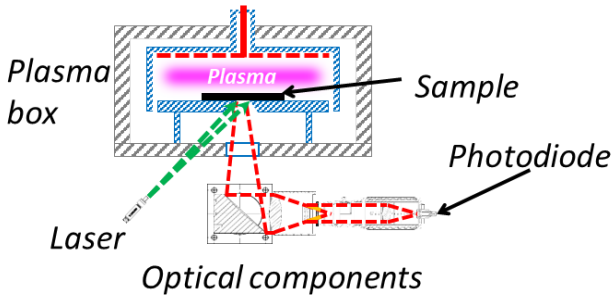

Figure 1: In-situ MPL setup with PECVD chamber

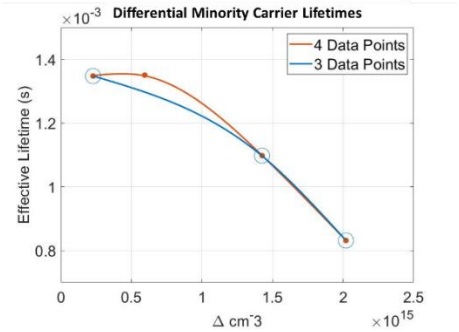

Figure 2: Effective carrier lifetime as a function of excess carrier density.

References:

[1] Giesecke, J. A., Glunz, S. W., & Warta, W. (2013). Determination of Actual Carrier Lifetime from Differential Measurements. *Energy Procedia, 38*, 59-65. doi:10.1016/j.egypro.2013.07.249

[2] Sreng, M., Silva, F. and Roca i Cabarrocas, P. (2019), In situ Photoluminescence Study of Plasma Effects on Passivation of Crystalline Silicon Coated with Aluminum Oxide. Phys. Status Solidi A, 216: 1800612. doi:10.1002/pssa.201800612