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Defect levels in $Cu(In,Ga)Se_2$ polycrystalline layers by sub-bandgap photo-induced current transient spectroscopy

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ABSTRACT

Photoinduced Current Transient Spectroscopy (PICTS) employing sub-bandgap excitation pulses is used for studying defect levels in polycrystalline thin films of $Cu(In,Ga)Se_2$ (CIGS). It is shown that the persistent photoconductivity effect accompanying photocurrent measurements distorts and often totally obscures PICTS spectra in the case of copper-poor polycrystalline layers. In order to overcome this difficulty, the use of sub-bandgap light in PICTS measurements is proposed. The results for both types of excitation – sub-bandgap (wavelength 1300 nm,) and above bandgap (wavelength 975 nm) – are compared. We show that sub-bandgap light provides better-resolved PICTS spectra than in case of standard measurements when contribution of photocurrent decay due to persistent photoconductivity is significant. The results for a set of CIGS polycrystalline layers fabricated using various preparation protocols are shown and discussed. Two most pronounced peaks are identified with transitions observed previously in the defect levels spectra of the $CuInSe_2$ and $CuGaSe_2$ epitaxial layers.

Keywords: Cu(In,Ga)Se2, photocurrent, PICTS, defect levels, persistent photoconductivity

1. Introduction

Intrinsic defects in $Cu(In,Ga)Se_2$ (CIGS) have been a subject of intense investigation for decades. Junction capacitance techniques allowed determination of some characteristics of defect levels. The advantage of this approach is that the measurements are conducted on the