Characterization of Subgap Density-of-States from Sub-bandgap Optical Charge Pumping in $In_{0.53}Ga_{0.47}As$ MOSFETs

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For consistent characterization and modeling of $In_{0.53}Ga_{0.47}As$ MOSFETs, extraction of the subgap density-of-state distribution (g(E)) over the subgap energy range (E_V<E<E_C) is very important for electrical properties and device reliability. In the extraction of the g(E) through the capacitance-voltage (C-V) measurement, we employed the difference of the experimental photonic C-V data and dark C-V data. We used equivalent circuit model for the photo-responsive carriers excited in $In_{0.53}Ga_{0.47}As$ MOSFET as shown in Fig. 1. (f). In this model, the photo responsive capacitance ($C_{LOC,ph}$) is included for the carriers generated from g(E) in the $In_{0.53}Ga_{0.47}As$ channel. Thus, the extracted g(E) is obtained only for the sub-bandgap range which is determined by the wavelength of the optical source used in the experimental. This means that if the wavelength of the optical source is provided such that the photon energy(E_{ph}) is approximately equal to the bandgap energy(E_g), the full range subgap DOS can be obtained. The extracted g(E) in $In_{0.53}Ga_{0.47}As$ MOSFETs through the sub-bandgap optical charge pumping technique is shown in Fig. 1. (e)

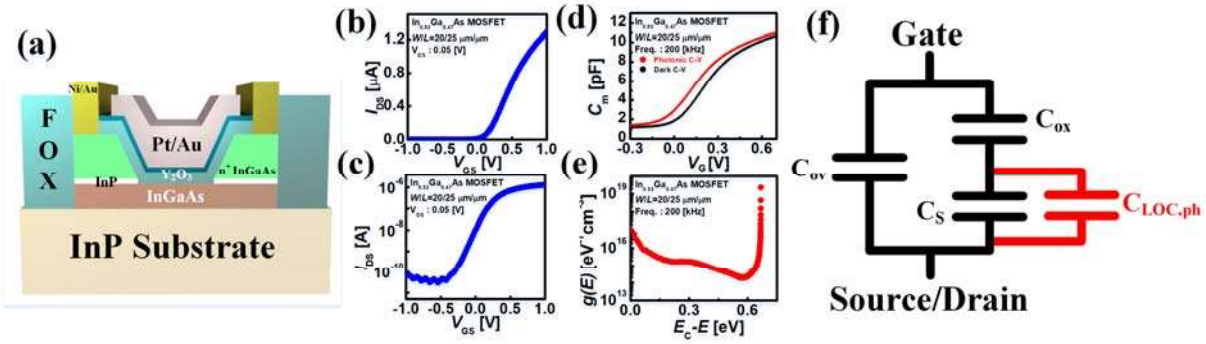

Fig 1. (a) Schematic image of $In_{0.53}Ga_{0.47}As$ MOSFET. (b) and (c) Measured I-V characteristics. (d) Measured C-V characteristics under dark and photonic states. (e) g(E) obtained from the monochromatic photonic capacitance-voltage technique [1]. (f) Equivalent circuit model of $In_{0.53}Ga_{0.47}As$ MOSFET.

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References [1] H.Bae, *et al*., *IEEE Electron Device Lett*., vol. 34, no. 12, pp. 1524-1526(2013).