Electrical and optical characterization of proton-irradiated GaInP/GaAs/Ge triple-junction solar cells

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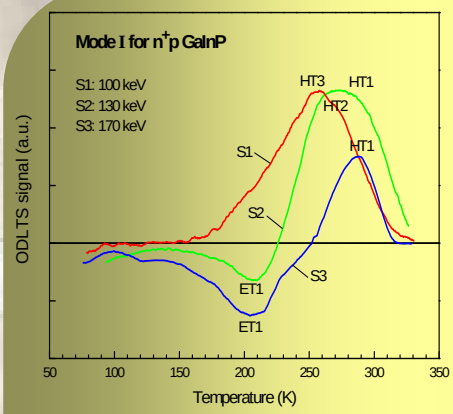
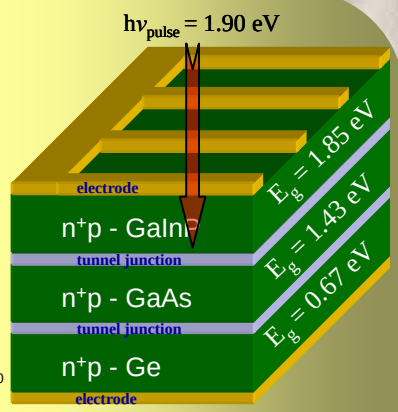
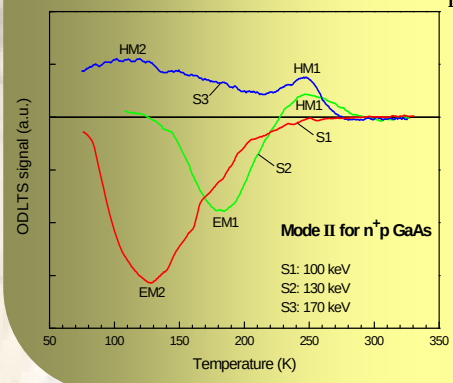
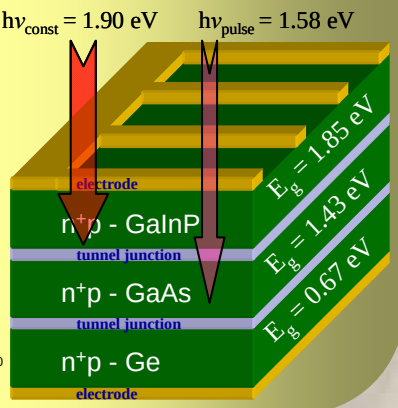
Motivation

- One triple-junction solar cell contains three p-n junctions in series and it is difficulty to characterize properties of each one individual junction. Proton irradiation could induce defects, the distribution of which depends on the proton energy.
- Based on the selective light-absorption of the three junctions, optical deep-Level transient spectroscopy (ODLTS) technique was used to detect the induced defects directly.
- With the simple equivalent circuit selected, capacitance and resistance of each one of the three junctions could be obtained by fitting of impedance spectroscopy (IS).



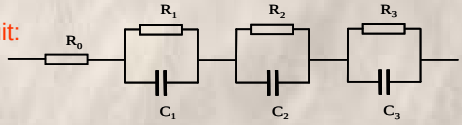


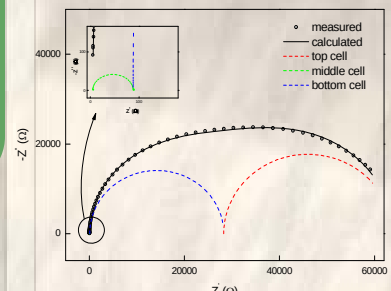




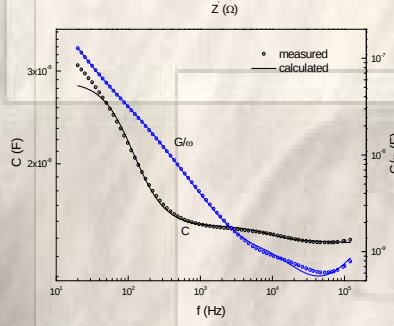
IS measurements

Equivalent circuit:



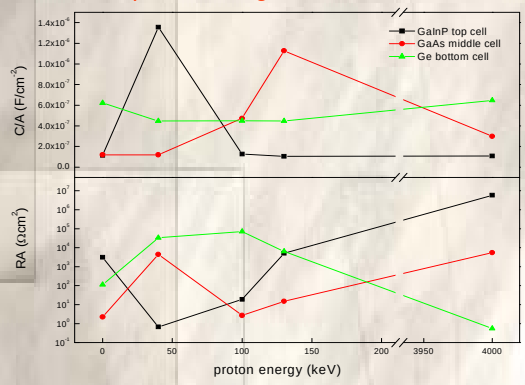


Irradiated by 130 keV proton, typical impedance Cole-Cole plot

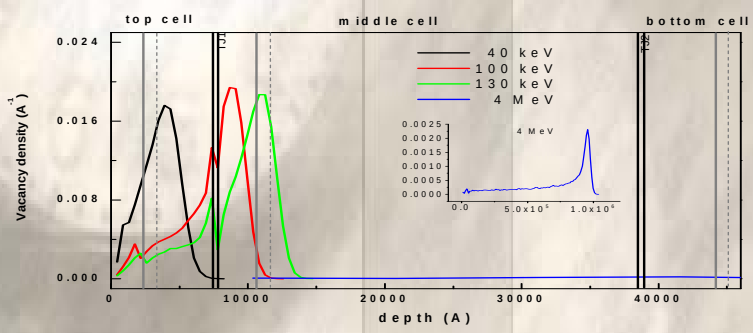


Frequency dependence of C and G/ω

Obtained capacitances and resistances for different proton energies



Irradiation Simulation



Conclusion

1. Active energies and concentrations of defects are obtained by ODLTS measurements.
2. Capacitance and resistance of each junction are obtained by IS measurements.
3. All the measured variety of concentration depending on proton energy agrees well with the irradiation simulation.