

Fundamentals of Impedance Spectroscopy

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Impedance Spectroscopy (IS) is a powerful characterization technique that can be applied to different electronic devices, such as LEDs, LASERs and Solar Cells, in order to get information about carrier dynamics inside the device. It consists on superimposing a small signal voltage, v_{AC} , to a DC voltage, V_{DC} , and measuring the alternating current response, i_{AC} . Impedance is defined as $Z = v_{AC}/i_{AC}$. Varying the frequency of the signal, typically from 0.1 Hz to 1 MHz, different dynamical processes, with different time constants, can be characterized (ions motion, carrier recombination, carrier diffusion, etc). Impedance spectra are fit using equivalent circuits composed of resistances and capacitances. From the circuital parameters, different physical parameters such as recombination lifetime, diffusion time, mobility, etc. will be extracted. In this lecture IS will be applied to both organic and perovskite solar cells.