inam
Institute of Advanced Materials
UJI Castelló

Extracting Defect Density from Capacitive Methods?

Germà Garcia-Belmonte, Osbel Almora, Marisé García-Batlle

Institute of Advanced Materiasl (INAM), Universitat Jaume I, Spain

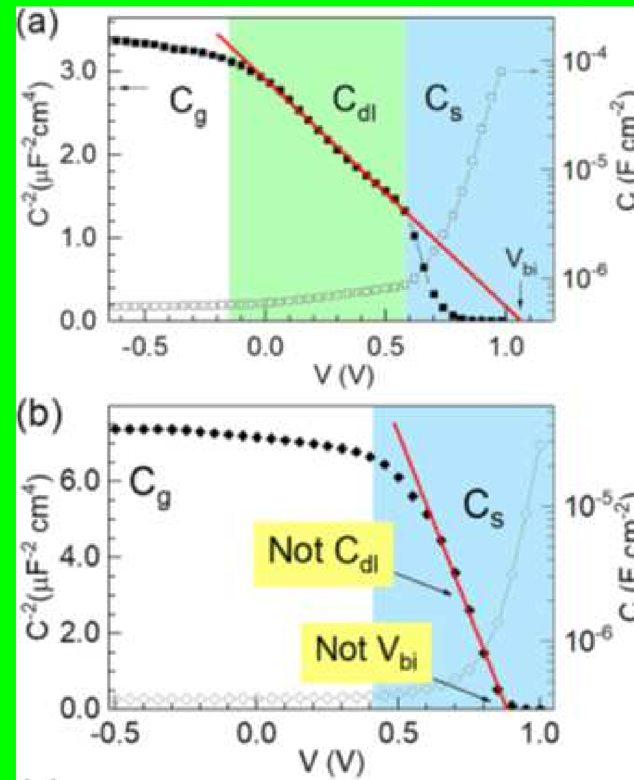
Background

Capacitive techniques (Mott-Schottky analysis and Admittance spectroscopy) probe the voltage-modulation of the depletion layer capacitance isothermally as well as under varying temperature. Capacitive methods have found difficulties when applied to elucidating bulk electronic defect bands in photovoltaic perovskites. This is because perovskite solar cells (PSCs) actually exhibit some additional capacitive features hardly connected to electronic defect dynamics. The commonly reported excess capacitance observed at low frequencies Cs is originated by outer interface mechanisms and has a direct repercussion on the evaluation of band gap defect levels.

Conclusions

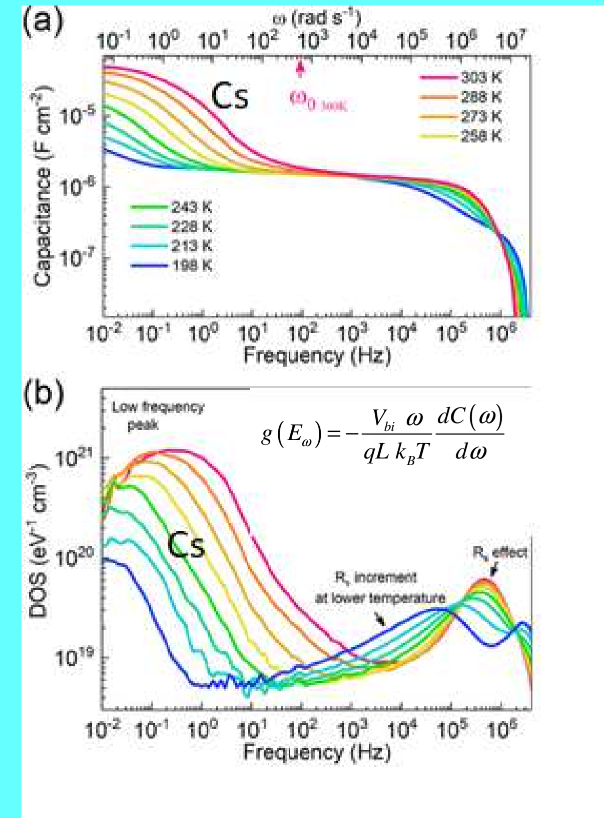
Capacitive techniques, when used uncritically, may be misleading and produce wrong outcomes because of the masking effect of Cs.

Mott-Schottky analysis



- Depletion capacitance Cdl related to the bias modulation of the electronic depletion layer.
- Accumulation capacitance Cs dominates at large forward bias.
- The distinction of Cdl from Cs needs of perovskite layers containing significant defect density (>10^{17} cm^{-3}).

Admittance spectroscopy



- Defect level extracted from the frequency derivative of the capacitance spectra.
- Low-frequency capacitance not related to defect density.
- As occurring with Mott-Schottky analysis, a masking effect appears by C_s

O. Almora, M. García-Batlle, G. Garcia-Belmonte. *J. Phys. Chem. Lett.* **10** (2019) 3661–3669
O. Almora, C. Aranda, E. Mas-Marza, G. Garcia-Belmonte. *Appl. Phys. Lett.* **109** (2016) 173903