# Accurate determination of band tail properties in amorphous oxide semiconductors with Kelvin Probe Force Microscopy

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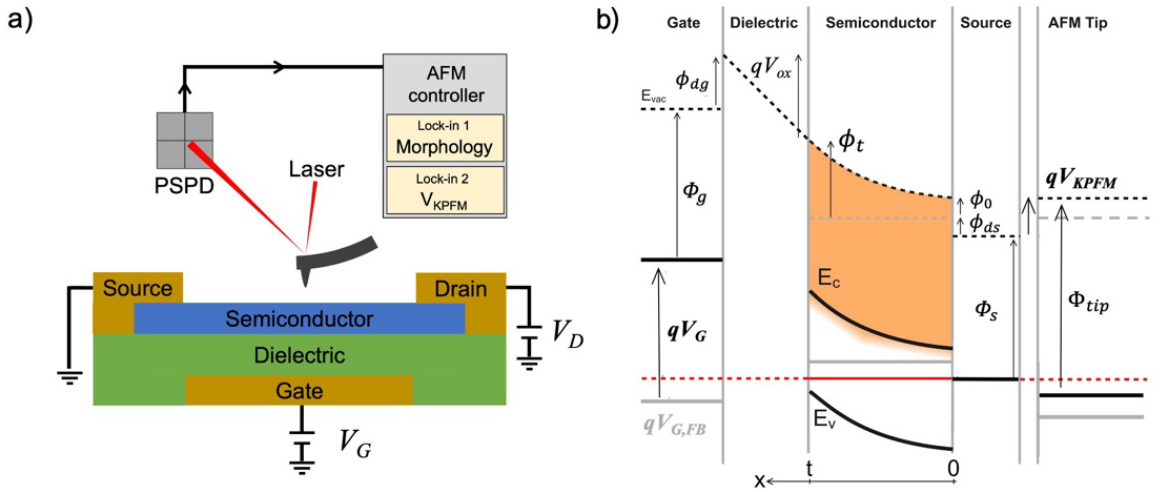
The disordered microscopic structure of amorphous oxide semiconductors causes the formation of band tails in the density of states (DOS) that strongly affect charge transport properties. Such bandtail properties are crucial to understand for optimizing thin film device performance with immense relevance for large area electronics. Among the available techniques to measure the DOS, KPFM is exceptional as it enables precise local electronic investigations combined with microscopic imaging. However, a model to interpret KPFM spectroscopy data on amorphous semiconductors of finite thickness is lacking. To address this issue, we provide an analytical solution to the non-linear Poisson's equation for a metal-insulator-semiconductor (MIS) junction interacting with the AFM tip, as shown in figure a. The solution enables us to fit experimental data for semiconductors with finite thickness and to obtain the DOS parameters, such as band tail width, doping density, and flat band potential. We validate our technique using both KPFM and photocurrent spectroscopy measurements on IGZO thin film transistors. We also demonstrate the effectiveness of our method by analyzing the impact of ionizing radiation on DOS properties. We obtain a local band tail width $E_t$=(44.4±0.1)meV which is in perfect agreement with our photocurrent spectroscopy results and we prove that x-ray radiation has no impact on DOS parameters but causes a static charge accumulation in the dielectric [1].




[1] L. Fabbri, C. Bordoni, P. Barquinha, J. Crocco, B. Fraboni, and T. Cramer, 'Accurate determination of band tail properties in amorphous semiconductor thin film with Kelvin Probe Force Microscopy', 2023, [Online]. Available: https://arxiv.org/abs/2303.08442