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Connecting electrochemical AFM techniques and traditional impedance spectroscopy

A number of scanning probe-based techniques have been used to study electrochemical behavior of materials on the nanoscale, but it is difficult to apply a generalized description to their results. Crystalline Sb_2S_3, an optical and electrical phase change material, is an example of a material that shows a strong electrostatic response in scanning probe experiments, where glassy Sb_2S_3 shows no such response. Here, with a generalized approach, we show a close similarity between frequency-domain impedance spectroscopy measurements and time-domain electrical scanning probe experiments. It is shown that dynamics from surface probe techniques correspond to the same low-frequency dielectric behavior as measured in bulk, on the macroscale. Using the distinctly different electrical characteristics of glassy and crystalline Sb_2S_3, we show that it can be used to probe local dielectric characteristics with high sensitivity and spatial resolution. We identify characteristics of this material system that enables this comparison as well as the limitations of the approach.

Topical Area

Hard matter: quantum, electronic, semiconducting materials

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