Abstract Submitted
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Polarization Selectivity of Aloof-Beam Electron Energy-Loss Spectroscopy[1] SOBHIT SINGH, YAO-WEN YEH, DAVID VANDERBILT, PHILIP E. BATSON, Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08854, USA — Scanning transmission electron microscopy (STEM) coupled with electron energy-loss spectroscopy (EELS) is widely used to probe the electronic properties of materials. In a recent work [1], we demonstrated that the aloof-beam EELS offers good polarization selectivity to detect the orientation-specific interband electronic transitions in one-dimensional ZnO nanorods without the requirement of sample reorientation. In particular, we experimentally observed the key anisotropic features at 11.2 and 13.0 eV differentiating the in-plane ($\boldsymbol{E} \perp$ to $c$axis) and out-of-plane ($\boldsymbol{E} \parallel$ to $c$axis) responses of wurtzite-ZnO nanorods to an external electric field ($\boldsymbol{E}$), as predicted by our density-functional theory calculations. We further observed some degree of orientation dependence at the onset of direct band gap transition near 3.4 eV, which was attributed to the splitting of the O-2p$_{xy}$ and O-2p$_z$ occupied states in the wurtzite structure. The fact that good polarization selectivity can be achieved by aloof-beam EELS while keeping the beam-to-specimen orientation fixed broadens the scope of the aloof-beam EELS technique for characterization of nanomaterials. [1] Yao-Wen Yeh, Sobhit Singh, David Vanderbilt, and Philip E. Batson, Phys. Rev. Applied 16, 054009 (2021).

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