Local charge measurement using off-axis electron holography

A model-independent approach based on Gauss' theorem for measuring the local charge in a specimen from an electron-optical phase image recorded using off-axis electron holography was recently proposed. Here, we show that such a charge measurement is reliable when it is applied to determine the total charge enclosed within an object. However, the situation is more complicated for a partial charge measurement when the integration domain encloses only part of the object. We analyze in detail the effects on charge measurement of the mean inner potential of the object, of the presence of induced charges on nearby supports/electrodes and of noise. We perform calculations for spherical particles and highlight the differences when dealing with other object shapes. Our analysis is tested using numerical simulations and applied to the interpretation of an experimental dataset recorded from a sapphire particle.

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