Tomographic reconstruction of defects in semiconductor nanowires

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Semiconductor nanowires have attracted considerable attention over the past twenty years for use in applications such as solar cells, light emitting diodes and new transistor designs[1]. Strict control over the manufacturing process is required, as it is well known that crystallographic defects can affect the physical properties of the nanowires[2]. Here we propose an approach that can be used to map the positions of defects such as dislocations in semiconductor nanowires quantitatively in three dimensions.

We acquire tilt series of high angle annular dark field images of a semiconductor nanowire in the scanning transmission electron microscope, using several camera lengths. We investigate using the subtraction of images acquired using different camera lengths to enhance diffraction contrast from defects at each specimen tilt angle, without introducing unwanted contrast from variations in specimen thickness. Tomographic reconstruction of the resulting difference images can then be used to visualize the defect distributions in three dimensions. We investigate the choice of camera lengths to use in such studies, and we discuss the origin and interpretation of the resulting contrast.

[1] L. Samuelson et al., Physica E **25**, 2 (2004)
[2] U. Krishnamachari et al., Applied Physics Letters **85**, 11 (2004)

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