Three-dimensional mapping of strain filed in SiGe thin film

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The understanding and manage of strain is of fundamental importance in the design and implementation of materials, and a key issue that determining the performance of semiconductor devices. Conventional x-ray diffraction techniques, although capable of measuring strain at very high accuracy, do not offer the spatial resolution needed for microelectronics. X-ray Bragg ptychography [1] is a new emerging technique to image strain noninvasively in an extended crystalline specimen with a resolution better than the beam size of the x-ray probe, ultimately enabling a 3D strain measurement at the nanoscale. In this work, we present a theoretical study on the effects of partial coherence, the overlap ratio and position uncertainty in Bragg ptychography, using synthetic data generated from forward simulation. The convergence of the reconstruction and the detection sensitivity of the strain field under various conditions are discussed. We also report a Bragg ptychography experiment on a SiGe thin film feature for 3D strain reconstruction by performing spiral 2D scans at different rocking angles. Reconstructed strains are compared to previously reported values and results obtained from theoretical modeling. Issues and challenges in the reconstruction are discussed as well.

References

[1] M.A. Pfeifer, G. J. Williams, I. A. Vartanyants, R. Harder & I. K. Robinson, Nature (London), **442**, 63–66. (2006).