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Coherent grating x-ray diffraction and its applications in semiconductor research

Qun Shen
Cornell High Energy Synchrotron Source (CHESS) and School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853, USA

We show that an x-ray interference phenomenon, Coherent Grating X-ray Diffraction (CGXD), can be used to obtain atomic-scale structural information and monitor structural changes of crystalline nanostructure (e.g., quantum wires and quantum dots) arrays. The grating interference of x-rays is similar to that of visible light, but since x-ray wavelengths are of the same order as inter-atomic spacing, an x-ray grating diffraction pattern contains the information about the internal crystal structures, and in particular, lattice strains, of submicron-scale grating features. Because of the interference effect in CGXD, it is possible to determine the distribution of strains in a quantum wire or dot structure, which is not easily available using other methods.

The grating superlattice reflections can also be measured in white-beam Laue method using highly collimated (coherent) polychromatic synchrotron radiation. This method can provide much faster data collection rate and may be useful in *in-situ* measurements of evolutions of nanostructure arrays. In the future, a highly coherent source such as APS will be very beneficial to this kind of studies.