Meetings International
SciTechnol
Chien-Nan Hsiao, J Nanomater Mol Nanotechnol 2018, Volume 7
DOI: 10.4172/2324-8777-C3-027

International Conference on

MATERIALS SCIENCE & ENGINEERING

June 25-26, 2018 | Rome, Italy

Atomic resolution characterization of epitaxial structure by using aberration-corrected STEM

Chien-Nan Hsiao
National Applied Research Laboratories, Taiwan

The atomic structure of epitaxial$Si_{0.81}Ge_{0.19}$/Si multiple quantum wells grown via molecular beam epitaxy on a single crystal silicon (100) substrate was investigated using an aberration-corrected scanning transmission electron microscope with energy distribution spectrometer. Also, the influence of various aberration coefficients such as defocus, astigmatism, coma, spherical aberration and star aberration on the shape of the probe and more importantly on the electron intensity distribution within the probe was calculated. The accuracy required for compensation of the various aberration coefficients to achieve subangstrom resolution with the electron optics system was evaluated by the calculation of phase shift. It was found that the interfacial layer was composed of a single silicon crystal coherently connected to an epitaxial $Si_{0.81}Ge_{0.19}$ layer. Moreover, the distance between the dumbbell structures of the Si and Ge atoms was revealed at the SiGe/Si interface along the (111) [110] orientation (Figure 1). The corresponding fast Fourier transform exhibited a subangstrom scale point resolution. Furthermore, the higher point resolution provided much improved signal sensitivity for the atomic arrangements at interfaces. The atomic EDS chemical mapping simultaneously interpreted with the dumbbell epitaxial SiGe/Si structure. The relative positions of the atom columns at interfaces in the X-ray chemical composition image could be directly interpreted from the corresponding incoherent high-angle annular dark-field image. Qualitative agreement was observed, and there was a one-to-one correspondence with the known projected atomic structure.

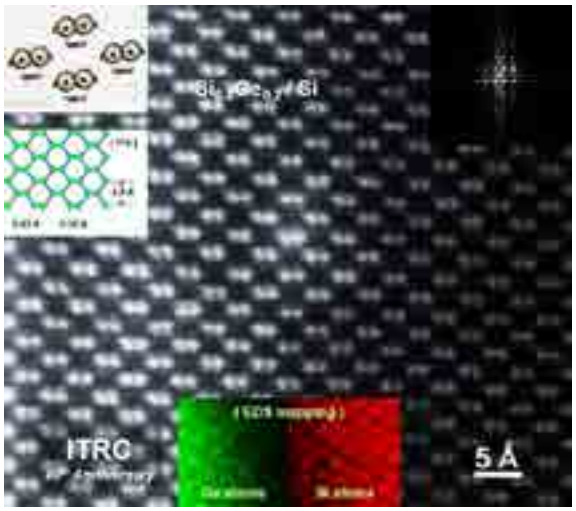

Figure1: High angle dark field image of SiGe/Si interface obtain by aberration corrected scanning transmittance electron microscopy. The atomic EDS chemical mapping simultaneously interpreted with the dumbbell epitaxial SiGe/Si structure.

Biography

Chien-Nan Hsiao received his Ph. D. in materials science and engineering from Taiwan University. He is currently a researcher and division director of vacuum technology at Instrument Technology Research Center, National Applied Research Laboratories.

0209347@narlabs.org.tw