Investigation of GaAs Nanowires using different accelerating voltages

Auchterlonie, G.[1], Shirai, M.[2], Watanabe, K.[3], Wepf, R.[1] and Zou, J.[4,1]

[1] Centre for Microscopy and Microanalysis, The University of Queensland, Australia, [2] Electron Microscope Application Group, Hitachi High-Technologies Corporation, Japan, [3] Hitachi High-Technologies Corporation, Japan, [4] Material engineering, School of mechanical and mining engineering, the University of Queensland, Australia

III-V semiconductor nanowires have been attracted extraordinary attention in recent years because of their unique physical and chemical properties, which in turn have the potential for them to be building-blocks for many advanced devices for nanoelectronic and optoelectronic applications. In general, nanowires are grown using catalysts, and these catalysts play a complicated role during nanowire growth. For this reason, understanding the role of catalysts and the quality of nanowires is critically important.

Advanced transmission electron microscopy (TEM) has been considered as a useful tool for determining the structural and chemical characteristics of nanomaterials and in particular their structure at the interface region. In recent years, with the development of chromatic aberration corrected, Cs-STEMs, investigation of nanomaterials at atomic scale become possible. In this study, Hitachi HTC has developed a new Cs-STEM (HF5000) that was used to study individual GaAs nanowires.

Figure 1 shows a set of Cs-STEM images taken at 200 kV, in which (a) is a secondary electron (SE) image, (b) is a STEM bright-field (BF) image, and (c) is the STEM High Angle Annular Dark Field (HAADF) image. The SE image shown in Figure 1(a) shows atomic resolution and thus this is a powerful and useful technique to determine the surface structure of the TEM specimens. In addition, the comparison of STEM images shown in Figure 1(b, c) and the SE image shown in Figure 1(a) indicates that the lateral crystalline region is narrower than the laterals dimension of SE image, indicating the possible electron beam damage. For this reason, 60 kV was used to investigate the nanowires damaged by the 200 kV electron beam. Figure 2 shows another set of Cs-STEM images taken at 60kV, in which significant damage induced by the 200 kV electron beam can be witnessed (particularly for the catalyst). Nevertheless, atomic resolution can be maintained, suggesting that low accelerating voltage may be needed for investigating beam-sensitive nanomaterials.

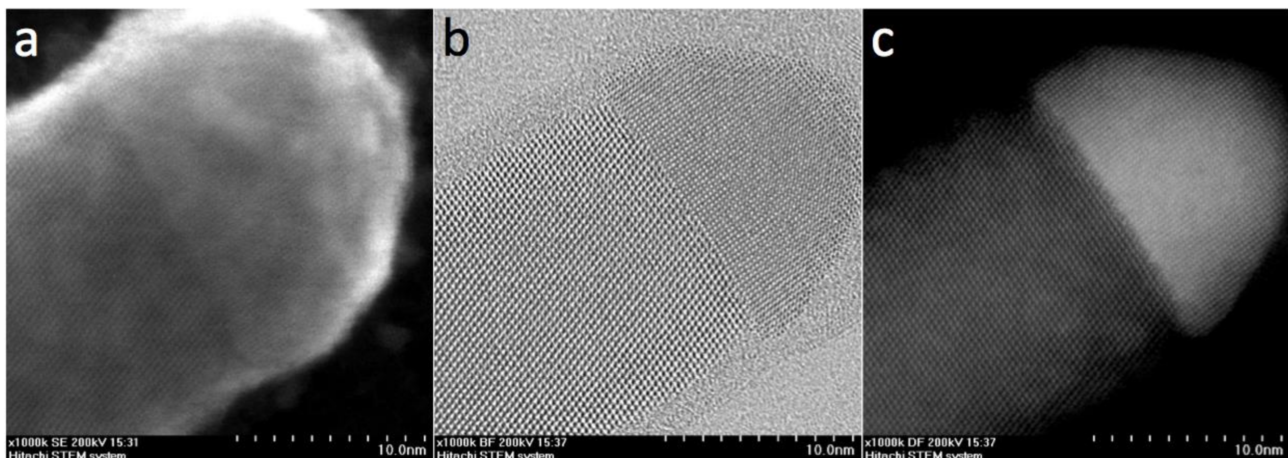

Figure 1 A suite of Cs-S/TEM images taken under 200kV (a) SE, (b) BF, (c) HAADF.

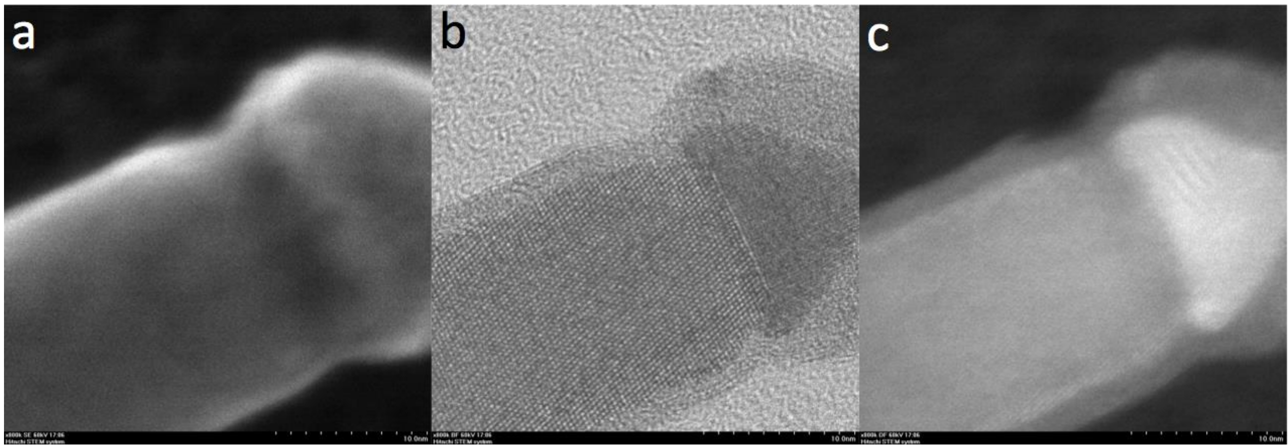

Figure 2 A suite of Cs-STEM images taken at accelerating voltages of 60kV (a) SE, (b) BF, (c) HAADF.

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