

Formation of In nanowires realized on Si(113) Surface

M. Xu, A. Okada, S. Yoshida, K. Kanazawa, K. Hayashi, O. Takeuchi and H. Shigekawa

Institute of Applied Physics, 21st Century COE, CREST-JST, University of Tsukuba,

Ibaraki 305-8573, Japan

As a highly anisotropic form of nanocrystal, nanowires (NWs), have been extensively studied due to their unusual physical properties and potential applications in nanoscale devices and interconnections. Nanowires on Si surfaces are of particular interest not only for their compatibility with Si-based device integration and also for the possibility to be used as model systems to explore phase transition and interesting quantum effects. Recently, a metal-insulator transition was found to appear as a result of Na-induced pinning of a charge density wave in quasi-1D metallic In chain on Si(111) surface. High-index Si(113) surface is a good substrate for the growth of 1D nanowires because of its structure anisotropy. Thus, we use it as the substrate for the growth of 1D In nanowires and study of their properties.

Our experiments were performed in ultra-high vacuum system (base pressure better than 1.5×10^{-8} Pa) equipped with a scanning tunneling microscope (STM). Clean Si(113) surface was obtained after outgassing the sample at the temperature of ~ 600 °C for 12 hours followed by slowly heating to 850~900 °C for 30 min and quickly flashing above 1200 °C. In deposition was carried out by using a resistant-heating evaporator with a flux of 0.4~6 monolayer (ML) per min.

It was found that a wetting layer was formed on Si(113) surface when about 1ML of In is deposited at substrate temperature of ~ 300 °C, as shown in Fig. 1(a). Figure 1(b) shows In clusters and atomic chains formed when more than 1ML In was deposited. We observed elongated In nanowires as well, as shown in Fig. 1(c), demonstrating the high potential of controllability and applicability of this system.

Contact: <http://dora.ims.tsukuba.ac.jp>

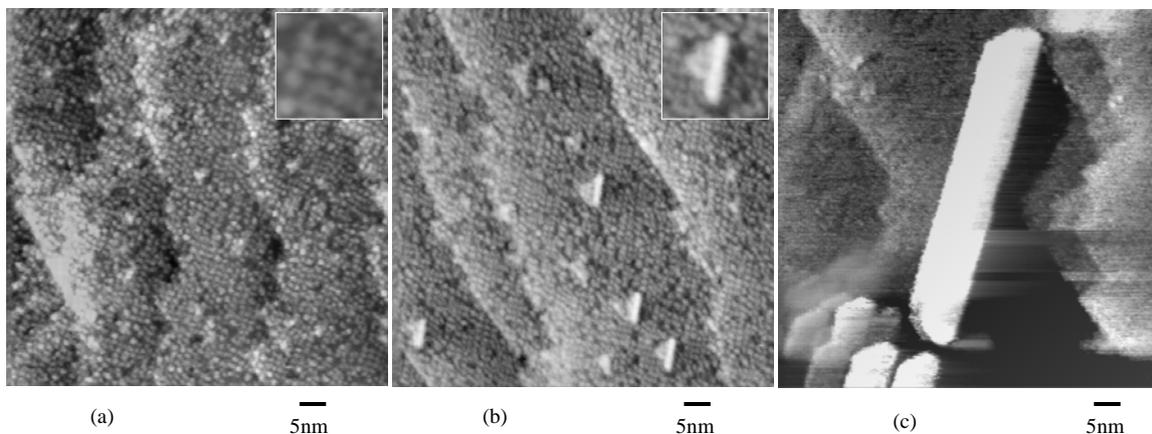


FIG. 1 STM images of (a) In thin layer grown after deposition of ~ 1 ML In at substrate temperature of ~ 300 °C (inset showing a small area image); (b) In clusters and atomic chains after deposition of more than 1ML In (inset showing a small area image of In atomic chain); (c) Elongated In nanowires formed. (The size of STM images is indicated as the scale bar.)