

2D Electronic Structures of Atomically Uniform Thin Film

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The atomically uniform thin film of Ag/Ge(111) has been investigated by high resolution angle resolved photoemission using Scienta 200 energy analyzer end station with U9-21B1 beam line. The surface state (SS) and quantum well states (QWS) of both first kind and second kind were examined at different coverage of Ag thin films (Fig 1). The initial energies of quantum well states of the first kind at zone center $\bar{\Gamma}$ and the second kind at zone boundary $\bar{A}$ of Ge(111) are properly approximated by Bohr-Sommerfeld quantization rule with phase shift as a linear function of energy.

Temperature dependence of these electronic states were also investigated. As shown in the Fig. 2(a), the line shape of the energy distribution curves (EDCS) of SS and QWS at $\bar{\Gamma}$ were examined in the temperature range between 20 K and 276 K for the Ag film of 15ML. We find that peak intensities decrease, binding energy shifts toward Fermi level, and linewidth broaden with increasing temperature both for the SS and QWS. Fig. 2(c) and 2(d) show the linewidth changes as a linear function of temperature for both SS and QWS. The electron phonon coupling constant λ can be thus extracted by the slope,

$$\lambda = \frac{1}{2\pi k_B} \frac{d(\Delta E)}{dT}$$

,which is 0.143 for SS, 0.07 for qws n=1, 0.02 for qws n=2, 0.34 for qws n=3. and 0.40 for qws n=4, respectively.

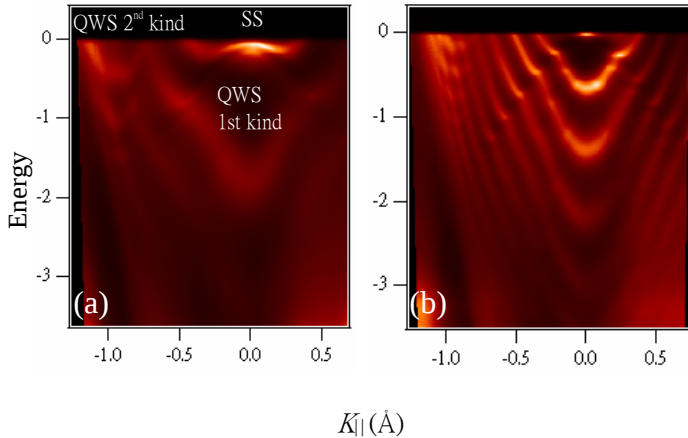


Figure 1. The 2D photoemission image of surface and quantum well state band dispersions for Ag/Ge(111);(a)N=7 ML; (b) N=15 ML.

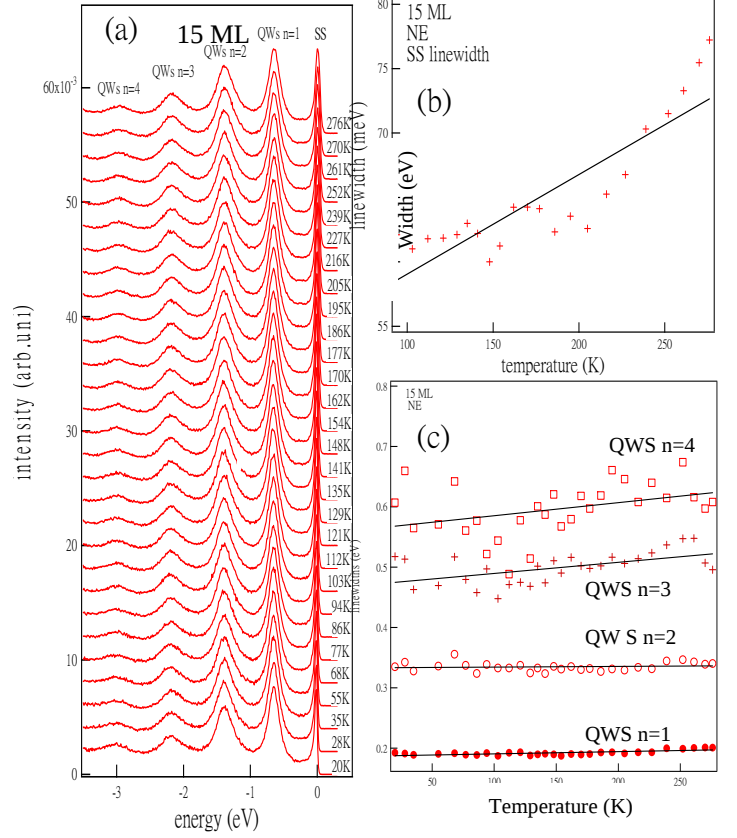


Figure 2. The temperature dependence of surface and quantum well states band dispersions for Ag/Ge(111) at the thickness of 15 ML in (a) EDCS (b) linewidth of SS (c) linewidth of QWS.