STM/STS study of anisotropic standing waves realized in self-assembled monolayers of amino acids on Cu(100) surface

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Formation and control of the novel low-dimensional electronic properties, based on the interactions between functional groups in organic nanostructures and solid substrates, is one of the most attractive goals of current researches. For amino acids, interactions are expected to be realized with the amino and carboxyl groups they have. In this study, as a first step for investigation and future controlling of 2D electronic states of organic films, we have performed scanning tunneling microscopy/spectroscopy (STM/STS) study on self-assembly monolayers of glycine and β-alanine molecules adsorbed on a Cu(100) surface.

A clean Cu(100) surface was prepared by Ar^+ sputtering and annealing (820 K) cycles in ultra high vacuum. Glycine or β-alanine molecules were evaporated from an Al_2O_3 crucible (350 K) to a Cu(100) substrate kept at room temperature. STM/STS measurements were performed at 5 K.

Figures 1(a) and 1(b) show dI/dV maps of glycine and β-alanine/Cu(100) obtained at +150 mV and +160 mV sample bias voltages, respectively. The appearance of the standing wave patterns, formed in the p(2x4) structures for both cases, indicate the existence of 2D electronic gas states. As shown in Fig.2, the dispersion relations, obtained from the analysis of the standing waves measured at various sample bias voltages, are very anisotropic. The effective masses along [110] and [-110] directions, for example, for the case of glycine molecules are 0.06 m_e and 0.6 m_e, respectively, which is independent of the original Cu(100) surface symmetry. These results clearly demonstrate the high potential of organic molecules for forming and designing novel 2D electronic states, for example, through the control of their functional groups. Details will be discussed at the colloquium.

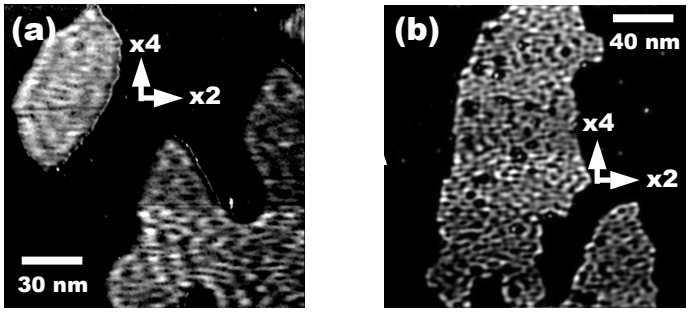

Fig. 1 dI/dV maps of (a) glycine/Cu(100) p(2x4) structure at V_s = +150 mV, and (b) β-alanine /Cu(100) p(2x4) structures at V_s = +160 mV, respectively.

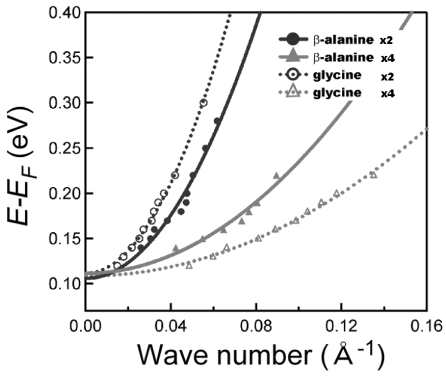

Fig.2 Dispersion relations.