

A novel electronic structure realized by glycine /Cu(111) self-assembly

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In recent years, molecular self-assembly has been attracting interest as a highly topical and promising field of research in nanotechnology to open a door toward realization of future molecular devices. Control of interactions on the molecular scale is a key factor in designing nanostructures and their properties for the application. The simplest amino acid, glycine, is one of the most favorable adsorbates that initiate a research to understand the mechanism of the interactions between the organic nanostructures and solid substrates. In addition, well-defined Cu single crystal surfaces are good candidates as a substrate for the purpose, since strong interactions are expected between molecules and the substrate [1,2]. In this study, we performed scanning tunneling microscopy/spectroscopy (STM/STS) on the self-assembled structure of glycine molecules adsorbed on a Cu(111) surface.

A clean Cu(111) surface was prepared by Ar⁺ sputtering and annealing (820 K) cycles in ultra high vacuum. Glycine molecules were evaporated from an Al₂O₃ crucible (350 K) to a Cu(111) substrate kept at room temperature. STM/STS measurements were performed at 5 K using an electrochemically sharpened tungsten tip ($\phi = 0.3$ mm).

Figure 1 shows a typical STM image and its magnifications observed at 5 K for the surface prepared by the adsorption of submonolayer glycine molecules. A hexagonal structure consisting of six trimers is clearly shown. Although some molecules adsorbed independently, as indicated by dotted circles in the high-resolution images, molecules form a trimer unit, regardless the place where they adsorbed. From these results, the self-assembled process is described as follows; first, the adsorbed molecules are stabilized by forming the trimer unit, and then they make a periodic structure through the balance of the interactions among the trimers and the substrate. In this process, the inter-molecular

hydrogen bonds between functional groups in glycine molecules are supposed to play an important role as a main driving force. A remarkable point is that the STS spectra measured on the Cu surface in the hexagonal structure is completely different from that of the base Cu surface (Fig. 2). Especially, the 2D electronic gas states of Cu(111) surface in the sample bias region from -400 mV to -100 mV drastically changes in the hexagonal trimer structure. Details will be discussed at the colloquium.

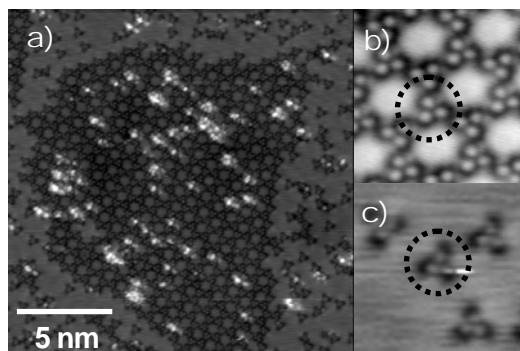


Fig. 1 STM image of self-assembled glycine molecules on a Cu(111) ($V_s = -0.5$ V $I = 1.0$ nA)

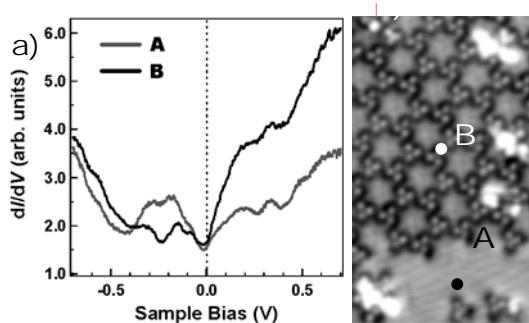


Fig. 2 (a) dI/dV spectra of a Cu(111) substrate (A) and a hexagonal area surrounded by glycine trimers (B) measured at the points indicated by A and B in (b), respectively.

References

- [1] K. Kanazawa *et al.*: Phys. Rev. Lett., **99** (2007) 216102.
- [2] K. Kanazawa *et al.*: J. Am. Chem. Soc., **129** (2007) 740.