3D18

Superstructures of meta-aminobenzoate on Cu(110) investigated with scanning tunneling microscopy and X-ray absorption spectroscopy

(東大院・新領域[1], 理研・表面化学[2], 理研・SPring8[3], 東大・物性研[4])

○Caroline Rabot[1], Shinji Doi[1], Masafumi Hori[2], Satoshi Katano[2], Yousoo Kim[2], Maki Kawai[1,2], Jun Miyawaki[3], Yasutaka Takata[3], Shik Shin[3,4]

In order to create and develop new functional materials, it is essential to understand how molecular superstructures form and are influenced by environment conditions such as coverage and temperature [1]. This knowledge can directly provide the ability to control and tune the properties of self-organized superstructures. Molecular systems are highly complex because several interactions are involved to stabilize the system [2,3] and the same molecules can form several superstructures that co-exist at the same coverage, as we observed for meta-aminobenzoate molecules on Cu(110) surface.

Here, we report that meta-aminobenzoate molecules form a variety of molecular structures and superstructures (Figure 1 a-d) when adsorbed on a Cu(110) surface. We also propose adsorption models for the main superstructures (Fig. 1 e-g). The proportion of the superstructures is strongly influenced by surface coverage and temperature. For example, although the superstructure of figure 1 b is dominant just after deposition, this is transformed into a more stable one (shown in Fig. 1 c) by thermal diffusion at room temperature (Graph. 1). As for the coverage dependence of the adsorption structure, although the molecules adsorb flat lying at low coverage, at high coverage very bright molecules are observed in the STM images (Fig. 2). By use of X-ray absorption spectroscopy, we proved that these very bright molecules are not at the second layer, but standing up molecules at the first layer.

References

1) X. Zhao, R. G. Zhao, and W. S. Yang: Langmuir 18, 433 (2002)

2) K. Kanazawa, A. Taninaka, O. Takeuchi and H. Shigekawa: Phys. Rev. Lett. 99, 216102 (2007)

3) K. Kanazawa, Y. Sainoo, Y. Konishi, S. Yoshida, A. Taninaka, A. Okada, M. Berthe, N. Kobayashi, O. Takeuchi and H. Shigekawa: J. Am. Chem. Soc. 127, 740 (2007)

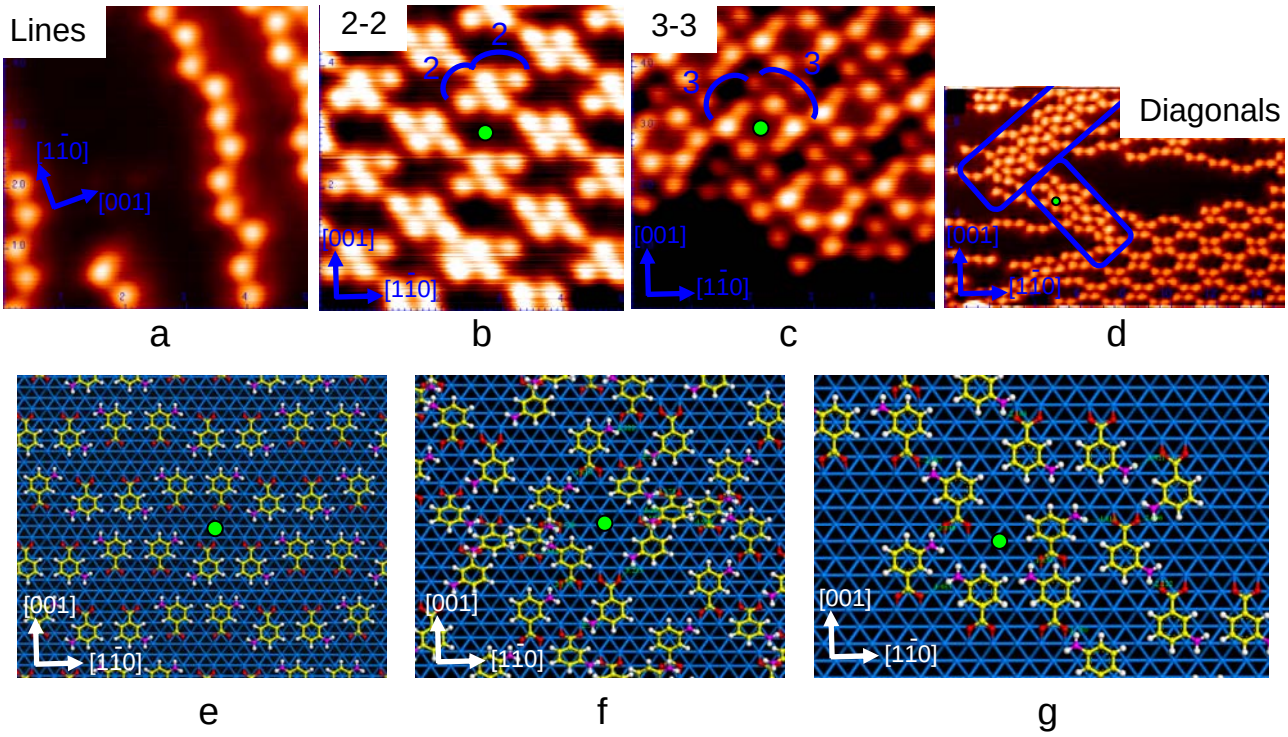
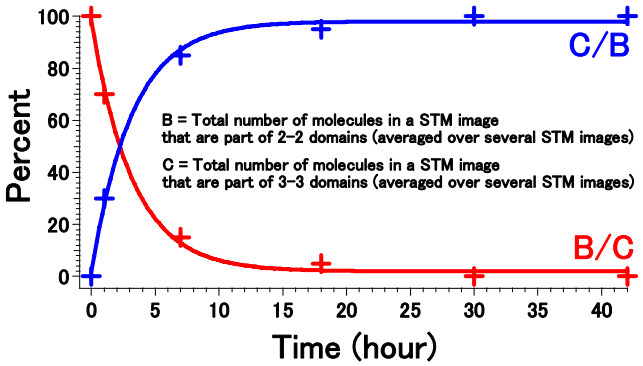


Figure 1. a-d. Main structures, that we call lines, 2-2 superstructure, 3-3 superstructure and diagonals. d. the 2 structures circled in blue are equivalent by mirror symmetry with respect to the [1$\bar{1}$0] direction. e,f and g. Proposed molecular arrangements for the superstructures shown in images b, c and d, respectively. Colors' meaning: blue mesh: Cu lattice, white: H, yellow: C, red: O and pink: N atoms. A green point in the images help finding the correspondence between the STM images and the proposed molecular models.



Graph 1. Time evolution of 2-2 and 3-3 superstructures. The 2-2 superstructure is replaced by the 3-3 superstructure by thermal diffusion at room temperature. The blue (red) curve shows the increase (decrease) of the proportion of 3-3 (2-2) superstructure with respect to 2-2 (3-3) superstructure.

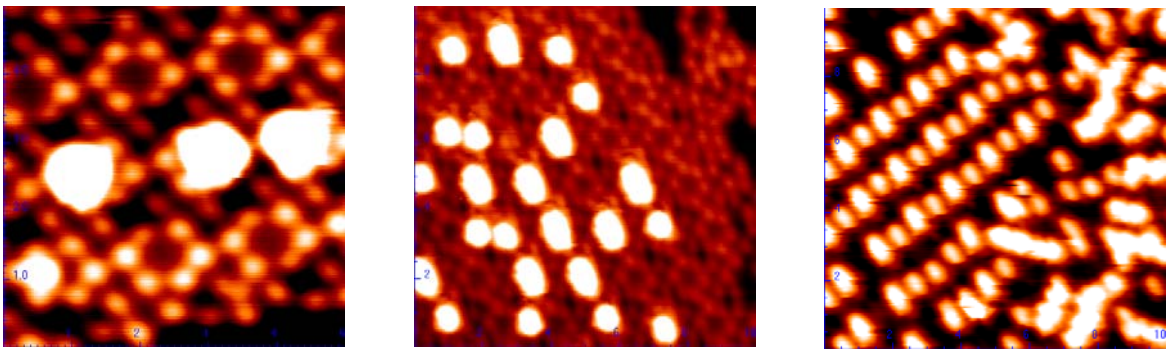


Figure 2. STM images of very bright protrusions formed inside 3-3 superstructure domains. a. Very bright protrusions start to appear due to coverage increase b-c. The number of very bright protrusions increases with coverage.