

ST-P005

## Two-dimensional Chiral Honeycomb Structures of Unnatural Amino Acids on Au(111)

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Crystallization has become the most popular technique for the separation of enantiomers since the Pasteur's discovery. To investigate mechanism of crystallization of chiral molecules, it is necessary to study self-assembled structures on two-dimensional surface. Here, we have studied two-dimensional self-assembled structures of an unnatural amino acid, (S)- $\beta$ -methyl naphthalen-1- $\gamma$ -aminobutyric acid ( $\gamma^2$ -1-naphthylalanine) on Au(111) surface at 150 K using scanning tunneling microscopy (STM). At initial stage, we found two chiral honeycomb structures which are counter-clockwise and clockwise configurations in one domain. The molecules are arranged around molecular vacancies, dark hole. By further increasing the amounts of adsorbed  $\gamma^2$ -1-naphthylalanine, a well-ordered square packed structure was observed. In addition, we found the other structure that molecules were trapped in the pore of the hexagonal molecular assembly.

**Keywords:** chiral molecules, self-assembly, scanning tunneling microscopy (STM)

ST-P006

## Adsorption and Thermal Reduction Mechanism of CO<sub>2</sub> on ZnO/Cu Model Catalysts

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Cu/ZnO/Al<sub>2</sub>O<sub>3</sub> is widely used methanol synthesis catalyst at elevated pressures P (50 to 100 bar) and temperatures T (473 to 573 K) using CO<sub>2</sub>, CO, H<sub>2</sub> syngas mixture. Although Cu step and planar defects have been regarded as active sites in this catalyst, detailed CO<sub>2</sub> hydrogenation procedure has been still unknown and debated as well as initial intermediate. In this study, we investigated the mechanism of CO<sub>2</sub> hydrogenation on Cu(111) model surface at P (1 bar) and T (298 to 450 K) using reflection absorption infrared spectroscopy (RAIRS). Two distinct formates by hydrogenation of CO<sub>2</sub>, on step and on terrace, show different behavior with elevating temperature. The peak intensity of on step formate was continuously decreased above 360 K up to 450K in contrast to the increase of on terrace formate. These phenomena are strong possibilities that the formate is initial intermediate and is desorbed by hydrogenation reaction because thermal desorption temperature of formate (~470 K) is much higher than desorption of on step formate. And the formate production peak of on step site was weakly correlated with CO formation.

**Keywords:** CO<sub>2</sub>, hydrogenation, Cu(111), formate, methanol