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Structural Control and Two-Dimensional Order of Organic Thiol Self-Assembled Monolayers on Au(111)

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Self-assembled monolayers (SAMs) prepared by sulfur-containing organic molecules on metal surfaces have drawn much attention for more than two decades because of their technological applications in wetting, chemical and biosensors, molecular recognition, nanolithography, and molecular electronics. In this talk, we will present self-assembly mechanism and two-dimensional (2D) structures of various organic thiol SAMs on Au(111), which are mainly demonstrated by molecular-scale scanning tunneling microscopy (STM) observation. In addition, we will provide some idea how to control 2D molecular arrangements of organic SAMs. For instance, the formation and surface structure of pentafluorobenzenethiols (PFBT) self-assembled monolayers (SAMs) on Au(111) formed from various experimental conditions were examined by means of STM. Although it is well known that PFBT molecules on metal surfaces do not form ordered SAMs, we clearly revealed for the first time that adsorption of PFBT on Au(111) at 75°C for 2 h yields long-range, well-ordered self-assembled monolayers having a $(2 \times 5\sqrt{13})R30°$ superlattice. Benzenethiols (BT) SAMs on gold usually have disordered phases, however, we have clearly demonstrated that the displacement of preadsorbed cyclohexanethiol self-assembled monolayers (SAMs) on Au(111) by BT molecules can be a successful approach to obtain BT SAMs with long-range ordered domains. Our results will provide new insight into controlling the structural order of BT or PFBT SAMs, which will be very useful in precisely tailoring the interface properties of metal surfaces in electronic devices.

References

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