Stripe formation and correlated molecule hopping in 1.4 × 1.4 monolayer phase of CO/Cu(111)

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Carbon monoxide adsorbed on a Cu(111) substrate is a prototype system of surface science. At low temperatures, CO forms monolayers in various ordered phases which have been been identified by low-energy electron diffraction, but the molecular arrangement has remained elusive because of a lack of atomic-scale imaging results. Here we report the first real space observation of the 1.4 × 1.4 phase by scanning tunnelling microscopy (STM) performed at T= 5K. On top of the regular 1.4 × 1.4 molecular lattice, we observe the formation of stripes with an average width of 2.5 CO rows, corresponding to a quasiperiodic sequence of bright single or double CO rows alternating with dark single CO rows. The dark rows are attributed to CO molecules on bridge adsorption sites. The bright rows correspond mainly to top sites but d*I*/d*V* measurements indicate that they contain about 1/3 of bridge sites. On a time scale of minutes, the stripes locally rearrange, which is explained as the collective hopping of several CO molecules between bridge and top sites. The hopping is likely to be triggered during scanning by the repulsive interaction between the CO-functionalized tip and the adsorbed CO molecules.

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