Controlling Localized States of Magnetic Molecules on Au(111) by Metallic Adsorbates

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Sensing and controlling spin interactions of magnetic molecules has been actively studied due to their possible applications in molecular spintronic and qubit devices. One prominent example is the tuning Kondo resonances, caused by spin interactions between molecular spins and spins of conduction electrons of metallic substrates. This tuning has been achieved through the reactive binding of small magnetic and non-magnetic molecules such as NO, O_2, NH_3, and NO_2 to magnetic molecules of metallo-porphyrins [1-4]. However, study on the binding of metallic atom has been limited. Here, we demonstrate that the adsorptions of metallic atoms can control the Kondo resonances of Co-porphyrin on Au(111), as revealed using scanning tunneling microscopy and spectroscopy (STM and STS). We observed several adsorbate-induced complexes in STM images, and proposed their atomic structures based on the results of density functional theory calculations. Our STS results were explained with the redistribution of unpaired spins of Co-porphyrins by the binding of magnetic atoms. Our study shows the spin states and interactions of metallo-porphyrins can be controlled not only by the binding of small molecules but also by the binding of metallic atoms.

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