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One-dimensionally Ordered Array of Co and Fe Nanoclusters on Carburized-W(110) via Template Assisted Self-Assembly

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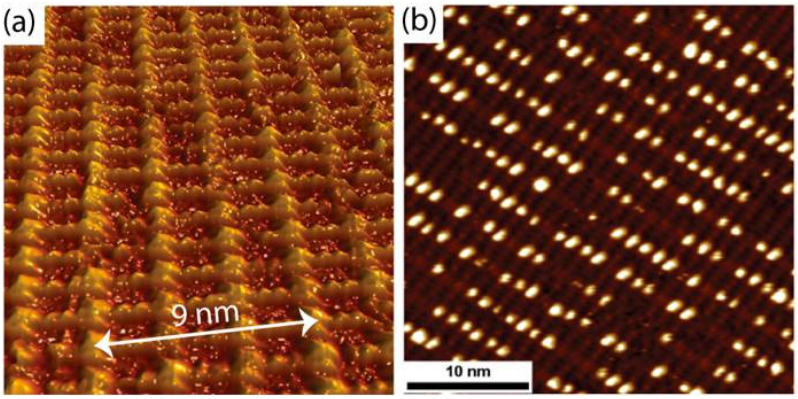
Carbon atoms near the surface of W(110) induce reconstructions such as R(15×12) -C/W(110) which consists of two characteristic parts, one square shaped and bright protrusion and two smaller ones. In the atomic resolution STM image, the bigger protrusion shows the periodicities of clean W(110), indicating that it is almost carbon poor region. The smaller protrusion contains hexagonal carbide surface layer of α-W2C on W(110). Employing this carburized W(110) as templates, we grow Co and Fe clusters of less than ten atoms. Due to the selectivity of bonding sites, growth of larger cluster is highly unfavorable for Co and the size of clusters is very uniform. Since Co atoms prefer to sit on the bigger protrusion rather than smaller one, Co cluster can be arranged one-dimensionally in R(15×12)-C/W(110) with quite uniform size distribution. However, Fe clusters sit on both sites without favored site, but still with uniform size distribution. On the other hand, Fe clusters can be grown with quasi one-dimensional order in R(15×3)-C/W(110), which consists of only smaller protrusions. We investigate the magnetic properties of the ordered nano-sized clusters. Experiments using XMCD reveals little magnetic moment of Co cluster on R(15×12)-C/W(110). This observation is consistent with the predictions of our first principles calculations that small Co clusters can be nonmagnetic or antiferromagnetic with low mean magnetic moment per atom.

Keywords: self-assembly, template assisted, nono-cluster


(a)
9 nm
(b)
10 nm