SF-P023

Carbon-induced reconstructions on W(110)

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Today, vast attention has been paid to periodic arrays of nanostructures due to their potential for applications such as memory with huge storage density. Such application requires large-scale fabrication of well ordered nano-sized structures. One of the most widely used methods for the ordered nanostructures is lithography. This top-down process, however, has the limit to reduce size. Here the promising alternative is the self-organization of ordered nano-sized structures such as large scale 2*d* carbon-induced reconstructions on W(110).

In the present study, we report on the first well-resolved atomic resolution STM studies of the well-known R(15×3) and R(15×12) carbon induced reconstruction of the W(110). From the atomic image of R(15x3) for different values of tunneling gap resistance, we can tell there are no missing atoms in unit cells of R(15x3) and some atomic displacements are substantial from the clean W(110), even though not all the imaged position of atoms correspond to tungsten, but may include those of carbon. We are considering two cases; First case is related to lattice deformation, or top layer of W(110) is deformed in the process of relief of strain caused by random inserting of carbon atoms possibly in the interstitial position. In the second case, R(15x3) unit cell results from a coincidence lattice between clean W(110) substrate and tungsten carbide overlayer which has rectangular atomic arrangement and giving R(15x3) coincidence lattice. beta-W2C showing rectangular unit cell should be a candidate.

Further, we report on new reconstructions. Unlike the well-known R(15x12) consisting of two parts, two inner structures between two "Backbone" structures. The new reconstruction, which we found for the first time, contains more parts between the "Backbone"s. Sometimes we can observe the reconstruction consists of only inner parts without "Backbone" parts. Thus, the observed reconstruction can be built by constructing of two types of "Lego"-like block. Moreover, the rectangle shape of "Backbone" transform to parallelogram-like shape over time, the so-called wavy-R(15x12). Adsorption of hydrogen can be the reason for this transformation.