

Reactive Versus Noble Metal Adsorption On $\text{TiO}_2(110)1 \times 1$

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A significant difference might have been expected between the growth behaviour on a metal oxide of reactive metals such as Fe and Cr on the one hand and noble metals such as Cu on the other. However, so far the main difference observed has been associated with the degree of wetting of three dimensional metal clusters [1]. Here we examine the difference in the very early stages of metal growth on $\text{TiO}_2(110)$ between the first row transition metals Fe, Cr and Cu, along with K as an example of a simple metal for which accurate calculations are available.

Results for K are in good agreement with recent calculations [2,3], evidencing a three fold hollow site in which K is bonded to two bridging O atoms and an in-plane O at bond distances of 2.73 Å and 2.49 Å (see fig.1). STM images of the K dosed surface contain wide dark rows running along the [001] direction. These are about 3 nm in length and centered along the dark bridging oxygen rows such that the two adjacent 5-fold coordinated Ti rows are not imaged. NC-AFM images of $\text{TiO}_2(110)1 \times 1$ -K contain zigzag rows are observed on the K-dosed surface, presumably arising from K atoms alternately occupying sites on either side of a bridging O row, as predicted by theory. The clustering of metal atoms, seen for K, is also observed in STM images of Fe and Cr atoms. Fe is only bound to O sites, whereas Cr is bound to both O and Ti sites. These results are consistent with earlier photoemission data. In contrast to the results for the reactive metals, in which transfer to the substrate has been evidenced, Cu atoms are only bound at O vacancy sites.

References

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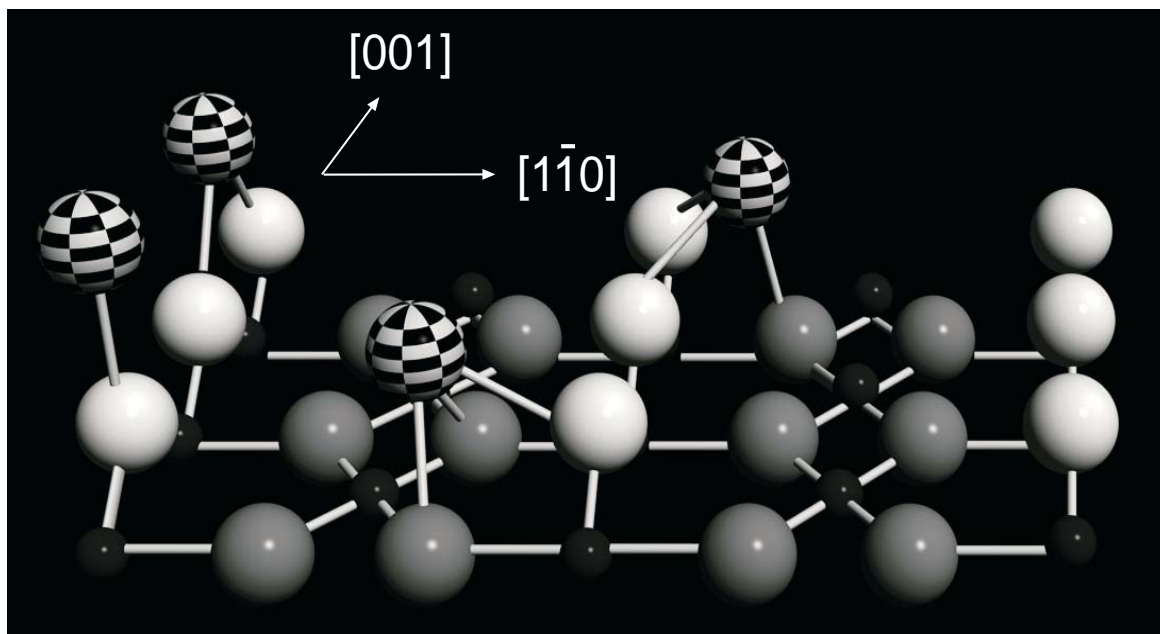


Figure 1. The four possible high symmetry sites for K adsorption on TiO₂(110), with K-O as nearest neighbours..