Poster

STM OBSERVATION OF DISLOCATION CONFIGURATIONS MOVEMENT BY NANOINDENTATION

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Nanoindentation has proved to be a technique capable of elucidating the mechanical properties of solid surfaces. Along with recent studies [1,2], our investigation deals with the initial stages of plastic deformation in a solid. In previous works [3,4] we have recognized and characterized by scanning tunneling microscopy (STM) the generation around a nanoindentation trace in Au(001) of two types of dislocation configurations: a) 'mesa'-shaped dislocation configurations (named as 'hillocks') and b) 'screw-loops', dislocation loops consisting of segments with a screw component that can wind up creating terraces. Both types of dislocation configurations can be accounted for in terms of the elastic theory of dislocations in a continuum [3,4] and of simulations based on molecular dynamics [3].

In this report, we present new results which give further information about the mechanisms involving dislocation generation and motion in Au(001). Nanoindentations are performed with the same STM tungsten tip which is also used to probe the reconstructed Au(001) sample, giving the possibility of exploring the nanostructure of the surface around the nanoindentation with a very high resolution. We show how the hillocks originated by a nanoindentation can be displaced after a second nanoindentation is made in the proximities of the previous one and how this displacement can be accounted for in terms of the stresses generated by the second indentation acting on the dislocation segments of the first. In a similar way, it is possible to trace the motion of the screw-loops by imaging the terrace left behind. The initial nanoindentation gives rise to terraces around the nanoindentation pit, from which the screw dislocation can be identified.The following nanoindentation close to the first one, modifies the original trace (Fig.). The new path described on the surface, as a result of the dislocation motion, is consistent with a previous model based on elastic theory [4] which explained the formation of the terraces. In conclusion, we give evidence of non-diffusive mechanisms, which are mediated by dislocation generation and motion, resulting in a substantial mass distribution around nanoindentations.

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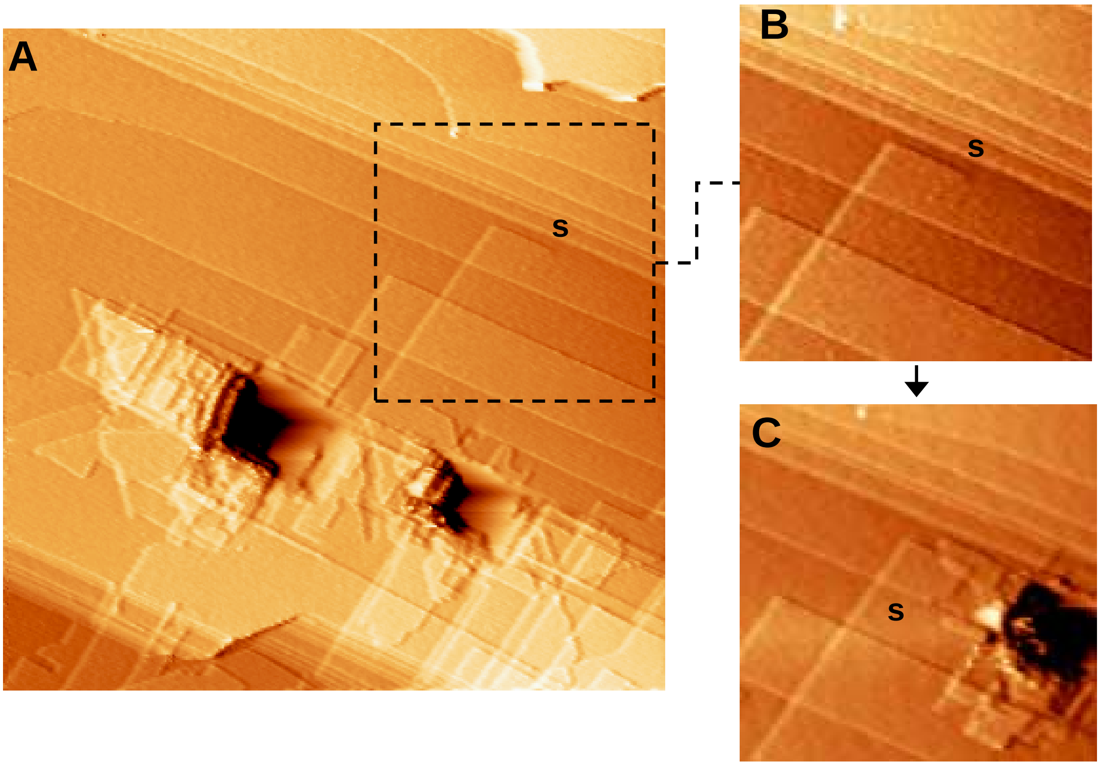

FIGURE:A) STM image (600x600 nm^2) of Au(001) after two nanoindentations are made with the STM tungsten tip. Terraces of straight edges in the neighborhood of the nanoindentations can be observed in both cases together with screw dislocations (*s* indicates the emergent point of a dislocation with a screw component perpendicular to the surface). B) Magnified image of the surface marked with dashed lines in A (250x250 nm^2). C) Same image area as B after a third nanoindentation next to *s*. A change in the trace left due to the screw dislocation gliding (*s*) is shown.