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OXYGEN INDUCED RECONSTRUCTION OF Ag(110)

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Abstract: The phonon spectrum of the (2x1)O-Ag(110) surface along the $\bar{\Gamma}\bar{X}'$ direction of the overlayer is studied by He inelastic scattering with time-of-flight detection. The Rayleigh mode behaviour strongly supports the occurence of an oxygen induced reconstruction of the Ag(110) surface.

The Ag(110) surface is well known to be an unique catalyst for ethylene epoxidation. Moreover, the catalytic action is significantly promoted by the presence of preadsorbed oxygen, which strongly increases the sticking coefficient for ethylene without partecipating in the oxidation reaction. Therefore, several studies to characterize structures, electronic states and vibrational modes of the chemisorbed oxygen phases were performed [1]. In spite of the large number of experimental and theoretical works on the subject, some questions still remain in debate. To shed light on some of these questions, the (2x1)O-Ag(110) vibrational spectrum was measured by He beam energy-loss spectroscopy. The experimental technique, the layer formation method and the surface phonon dispersion curves along the $\bar{\Gamma}\bar{Y}'$ direction of the overlayer were described elsewhere [2]. Briefly, an overall softening of the Ag(110) surface phonon spectrum after oxygen chemisorption was observed. In this paper, first results along the $\bar{\Gamma}\bar{X}'$ azimuthal direction are presented. Fig.1a) shows a typical time-of-flight (TOF) spectrum measured with surface temperature $T_s = 300^0$K. The incoherent elastic peak E and some structures associated to surface phonon creation/annihilation events are observed (time delay > 0 and < 0 respectively). In particular, structures denoted by S_1 describe a Rayleigh mode which appears to be extremely stiffened with respect to the same Ag mode [3]. To appreciate this the same TOF spectrum is plotted in an energy scale in fig.1b. The S_1 behaviour along $\bar{\Gamma}\bar{X}'$ together with the above mentioned results along $\bar{\Gamma}\bar{Y}'$ strongly support the occurence of large structural changes induced by oxygen chemisorption. Preliminary lattice dynamical calculations performed within a model with harmonic nearest neighbor interactions seem to confirm this possibility [4].

Thus Ag looks like Ni [5] and Cu [6] with respect to the oxygen presence.

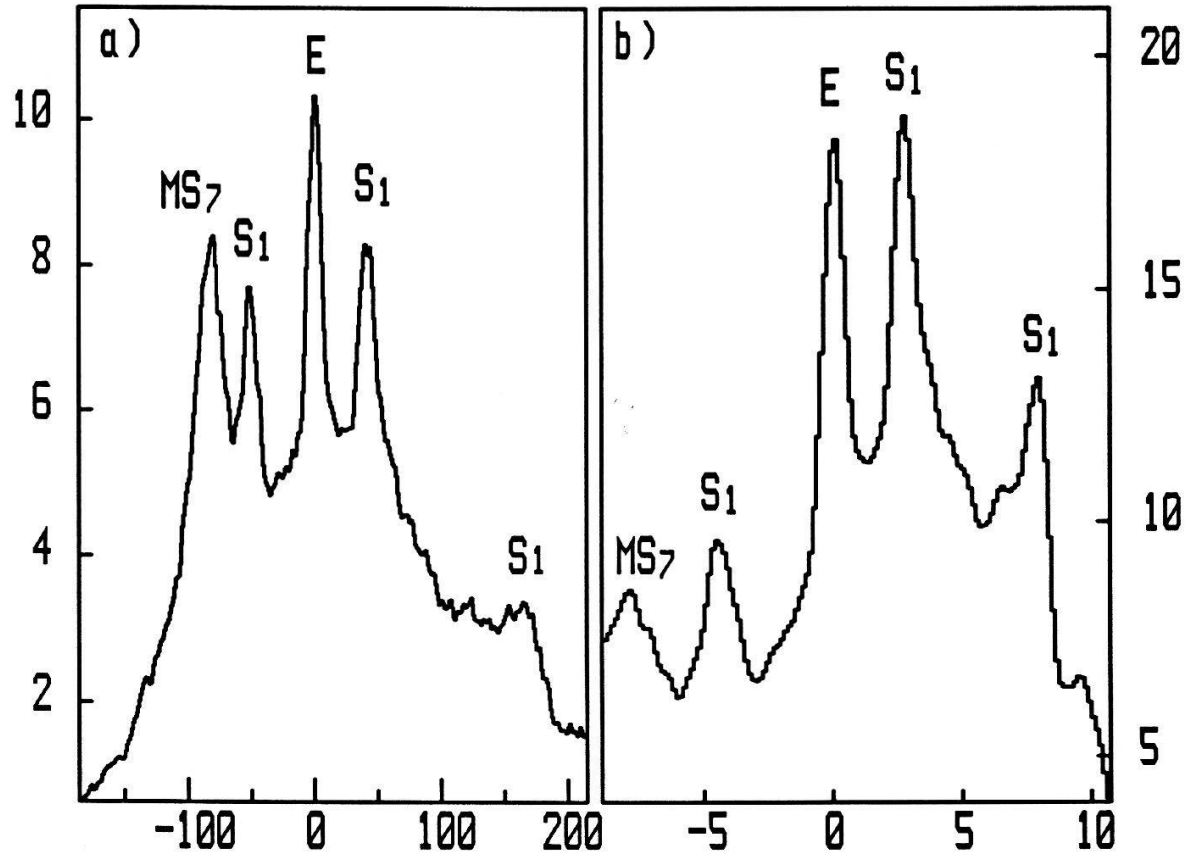

Fig.1 Scattered intensity (arb. units) versus a) time delay (μs), b) energy loss (meV) measured with E_{He} =17.5 meV, incident angle Θ_i = 49.9° and scattering angle Θ_f = 60.4°.

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