Alloying-induced change of surface stress and stress oscillations: Mn and FeMn on Cu(001)

D. Sander, W. Pan, J. Kirschner
MPI für Mikrostrukturphysik, Weinberg 2,D-06120 Halle, Germany

In situ stress, low-energy-electron diffraction (LEED) and medium energy electron diffraction measurements have been performed during the deposition of Mn and FeMn on Cu(001). The deposition of Mn at 300 K leads to the formation of the well known c-(2x2) MnCu surface alloy [1], as identified by LEED, see Figure 1(b). Its formation is identified by a compressive surface stress change, which grows in proportion to the Mn coverage and reaches –1.3 N/m at a coverage of 0.5, and levels off for larger coverage, as shown in Figure 1(a). Deposition at 420 K leads to an identical compressive surface stress change up to a Mn coverage of 0.5. However, further deposition at 420 K leads to an increase of the compressive stress, which reaches –2.3 N/m at a coverage of 1.3, where it levels off. LEED indicates the formation of a (4x2) structure, as shown in Figure 1(c)-(d). The results are discussed to illustrate the high sensitivity of stress measurements for the detection of the onset of the formation of different surface structures at a coverage, where LEED does not yet indicate a new structural phase. Measurements of monolayer stress oscillations during the growth of epitaxial FeMn layers on Cu(001) indicate the sensitivity of stress measurements even for the detection of subtle structural relaxation in nanoscale islands.

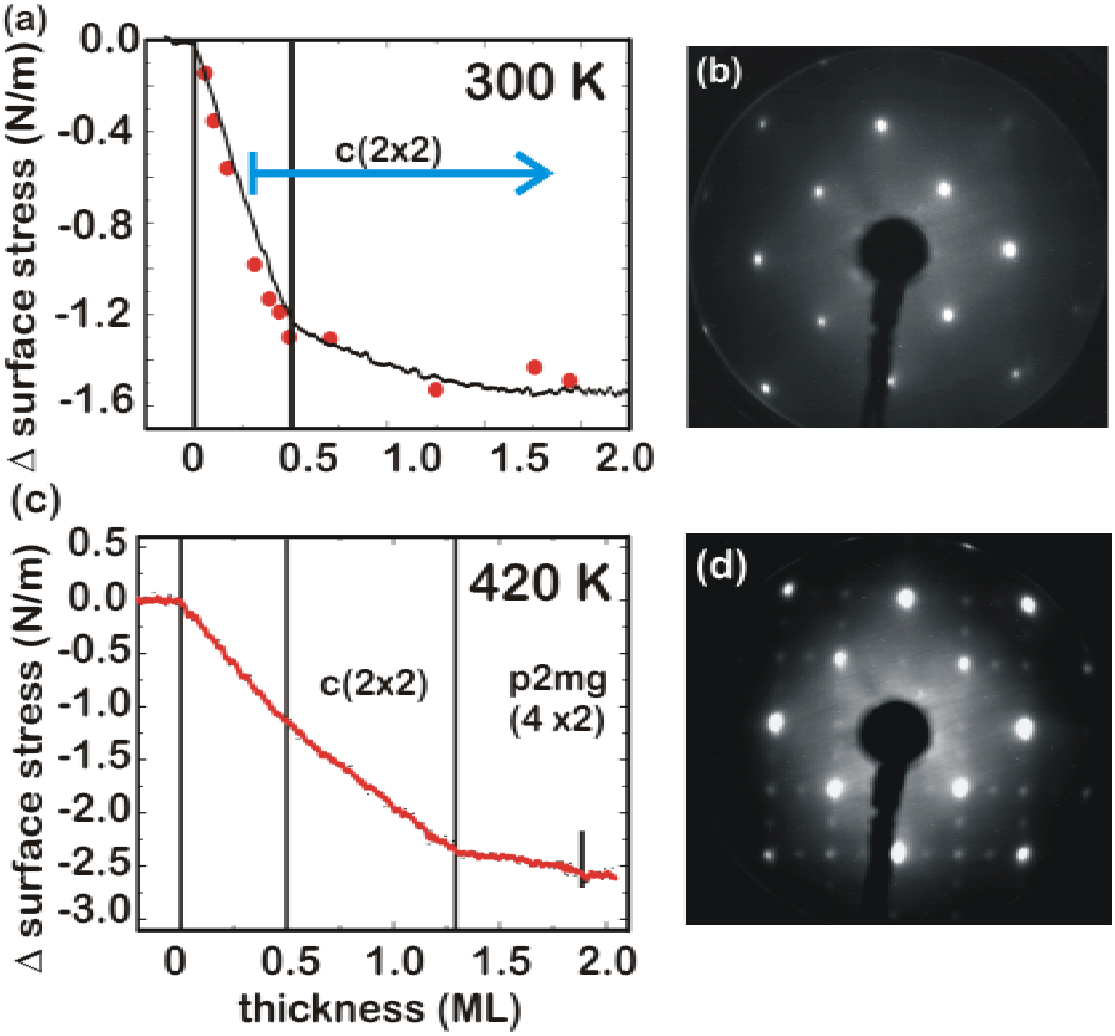

Figure 1. Stress measurements ((a), (c)) and low energy electron diffracation (LEED, 112 eV) pattern ((b), (d)) of the growth of Mn on Cu(001) at 300 K, top row, and at 420 K, bottom row. Deposition of Mn at 300 K induces compressive stress in proportion to the Mn coverage up to a thickness of 0.5 ML, where LEED indicates the formation of the c-(2x2) surface alloy, as indicated by the arrow and shown in (b). Deposition at 420 K leads to a compressive stress which increases up to a coverage of 1.3 ML, where LEED indicates the formation of the (4x2) p2mg pattern.

[1] Flores, Hansen, Wuttig, Surf. Sci. **279** (1992) 251.