Meyerheim *et al.* Reply: The preceding Comment by Liu *et al.* [1] is based on the implicit assumption that the growth behavior of Co on Cu (Ref. [2]) is the same as that of Ni on Cu (Ref. [3]). This may be true or not. No evidence has been given.

The criticism raised in the Comment is based on a scanning tunneling microscopy (STM) study on the interface formation of Co/($\sqrt{2} \times 2\sqrt{2}$)-O/Cu(001) [2], and also on STM work by Fujita *et al.* [4]. These papers focus on the interface formation during growth on the missing row (MR) reconstructed Cu(001) surface, whereas our study extends to larger film thickness, where we elucidate the film structure of surfactant-assisted growth as compared to nonsurfactant mediated growth.

The unique combination of surface x-ray diffraction (SXRD) and stress measurements [3] provides a detailed quantitative information on both structure and stress, which is not in contradiction with the experimental results published previously [2,4]. However, the claims raised in the Comment regarding the inappropriateness of our discussion in Ref. [3] are not justified:

Liu *et al.* question the validity of our structural model which was the starting point of the structural refinement. We refute this criticism, as our structural model considers all aspects of previous experiments and of our new results (see, e.g., Refs. [5], [7], [9], [10] of Ref. [3]). In addition, the following points clarify the strength of our SXRD analysis: (1) SXRD—in contrast to STM—probes the space-time average of the long range *ordered* structure. (2) In our experiments (Ni-coverage: 1.25–5.00 ML) we were studying the $c(2 \times 2)$ superstructure only. The ($\sqrt{2} \times 2\sqrt{2}$)-O/Cu(001) reconstruction is lifted after fractions (≈ 0.2) of a ML of deposited Ni. Therefore, we are not dealing with the initial growth regime. (3) We observe layer-by-layer growth of Ni on the oxygen precovered surface as evidenced by our SXRD measurements during deposition. (4) Ni and Cu atoms occupy hollow sites. (5) The $c(2 \times 2)$ superstructure reflections (see Fig. 2 of Ref. [3]) are due to the oxygen atoms residing in hollow sites on top of the film structure. (6) Surface roughness is taken into account by considering fractional occupancies of the adlayers (see Figs. 3 and 4 of Ref. [3]).

High quality fits [$R_u \approx 10\%$] are already obtained for the basic structure [remarks (4) and (5)]. Further refinement of this model ($R_u = 4.7\%$) corroborates our conclusion that oxygen atoms reside in subsurface sites. Supporting evidence for our starting model is abundant. For example, Lindner *et al.* [5] show an STM image of 5.5 ML Ni/O/Cu(001)-$c(2 \times 2)$, where Ni islands occupy about 50% of the surface. We disagree with the notion raised in the Comment that STM is the proper tool to analyze subtle changes of an adsorbate coverage quantitatively.

The authors of the Comment are right with their assertion that different Cu starting surfaces give rise to different stress behaviors. Our stress measurements do demonstrate that the stress change due to the growth of 8 ML Ni on clean Cu(001) with subsequent adsorption of oxygen in a $c(2 \times 2)$ structure on top of the Ni film is 0.51 N/m smaller than the stress change measured for the growth of 8 ML on the MR Cu(001). This result clearly proves that the stress change due to both preparations is different. This contrasts with the previous belief that both preparations lead to the same film or adsorbate structure.

Liu *et al.* claim that this conclusion is problematic as it neglects the different substrate surfaces, clean Cu(001) versus MR reconstruction. We cannot follow this line of thought, as the stress measurement takes this difference into account. Upon Ni deposition the MR structure disappears, see remark (2) above, and gets replaced with the Cu-Ni-O interface (see Fig. 3 of Ref. [3]). It would be wrong to include the stress change due to the formation of the MR reconstruction starting from clean Cu(001) [6] as a stress offset as we compare the stress at the termination of growth, where the MR of Cu(001) is lifted. The stress change due to the structural transition at the interface upon Ni deposition on the MR of Cu(001) is included in the stress curve of Fig. 1 in Ref. [3], and it shows up as the initial compressive stress change up to 1 ML deposition.

In summary, we refute the criticism regarding the validity of our analysis.

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[1] X.-D. Liu *et al.*, preceding Comment, Phys. Rev. Lett. **100**, 089601 (2008).
[2] X. Liu *et al.*, Appl. Phys. Lett. **88**, 133102 (2006).
[3] H. L. Meyerheim *et al.*, Phys. Rev. Lett. **99**, 116101 (2007).
[4] T. Fujita *et al.*, Appl. Surf. Sci. **130–132**, 491 (1998).
[5] J. Lindner *et al.*, Surf. Sci. **523**, L65 (2003).
[6] M. J. Harrison *et al.*, Phys. Rev. B **74**, 165402 (2006).