8 Summary and Outlook

In this thesis we presented investigations about the growth of Cu and Au on the Re(0001) surface.

The Cu TD-spectra show two desorption states in the temperature range between 950 K and 1150 K (β = 3.52 K/s). We assign these states to first layer and multilayer desorption. One further state (originating from second layer desorption) is not well resolved and appears only as a little shoulder on the multilayer peak. In the submonolayer range, we observe, with increasing coverage, a transition from a first-order to a zero-order desorption kinetics. We evaluated the following desorption energies: 291 kJ/mol for the first monolayer and 333 kJ/mol for the multilayer.
STM images, taken after deposition at room temperature, show for very small Cu-coverages exclusively heterogeneous nucleation. We observe fractal two-dimensional islands in the middle of the submonolayer range. These islands show partly misfit-dislocation structures of triangular shape. At higher temperatures (900 K), they fuse and form a compact Cu film. The first layer is approximately complete before the second begins to grow. In the second layer range, we observe, at elevated temperatures, meanderlike misfit-dislocation structures. These structures originate from the arrangement of 15 Cu atoms of the second layer over 14 Cu atoms of the first layer. In the first layer, the atoms have a pseudomorphical arrangement, i.e., Cu has the same lattice parameter as Re.

Our CO adsorption experiments on the bimetallic Au/Re(0001) show that Au – in contrast to Cu – forms a relatively open structure. The first layer is complete at coverages higher than Θ_{Au} = 1.7 ML. As similiarly found for Cu, the growth of Au on Re(0001) depends strongly on the preparation conditions. If we prepared the bimetallic sample at 100 K, Au seems to form initially statistically distributed twodimensional islands, whereas above 0.3 ML three-dimensional islands are growing. At higher temperature (900 K), these islands fuse and form a relatively compact two-dimensional Au film. At this temperature, the three-dimensional growth starts at about 0.8 ML.
The deposition of Au on Re(0001) causes only a small work function increase of about 80 mV, suggesting a small charge transfer from Re to Au. This small electronical interaction is in agreement with our results from CO TD investigations on the bimetallic Au/Re(0001) surface, because we noticed none, or only a very slight, shift of the CO TD signals relative to the clean Re(0001) surface.
Compared to Cu, Au desorbs at higher temperatures between 1100 K and 1375 K (β = 7.14 K/s). Accordingly, we foundlarger desorption energies of 343 kJ/mol for the monolayer (Redhead analysis) and 421 kJ/mol for the multilayer. Analogous to Cu we observed two desorption states, one for the multilayer and another for the monolayer. In contrast to Cu, Au desorbs with zero-order kinetics in the whole submonolayer range. The width of the multilayer state suggests the existence of a further Au desorption state, which

originates from the desorption of the second layer, similiar to our observations for Cu. However, this state cannot be resolved, because it overlaps with the multilayer state.

Our investigations provided also very interesting results about the interaction of CO with a bimetallic Au/Re(0001) surface.

The interaction between CO and Re on the gold-free areas of the bimetallic Au/Re(0001) surface is very similar to the interaction between CO and clean Re(0001). We could show that there is little, if any, influence of Au on the CO-Re bond. CO forms a terminal bond to Re also in the presence of Au. However, increasing gold coverage leads (according to condition of prepartion) to one to three further CO desorption states in the temperature range between 100 K and 270 K. These states originate from the interaction of CO with Au. The respective desorption maxima shift to lower temperatures with increasing Au coverage. The reason for this effect is the decrease of the electronical influence of the Re substrate with increasing Au coverage.

Detailed statements, especially to morphology and growth of Au films, can be given after carrying out STM-measurements. Because of technical and temporal reasons these measurements were not possible up to now. After the here presented detailed investigations of the bimetallic systems Au/Re(0001) and Cu/Re(0001), an extension to the ternary system Au/Cu/Re(0001) appears also very interesting.
Further detailed investigations also with other methods, for instance High Resolution Electron Energy Loss Spectroscopy (HREELS) and UV Photoelectron Spectroscopy (UPS), are necessary to clarify the nature of the new adsorption states, which we attribute to the interaction of CO with small Au particles.