0° in both the Ag and Fe yield suggests that the Ag and Fe atoms are present in the layer just below the Pb.

When the coverage is increased up to 10 ML of Fe, the azimuthal distribution obtained for the Ar/Pb yield is almost constant and the average yield has further decreased. On the other hand the average Ar/Fe yield has increased and shows features (dips at 0° and 45°, and peaks in between), which correspond to bcc Fe, present in the outermost layer. These results imply that the major part of the surface is still covered by Pb, but small parts of the surface consist of bare Fe. The surface has become rougher or more disordered on an atomic scale. Note that also an appreciable amount of Ag is visible, showing that it is still possible for part of the Ag atoms to reach the surface layers.

In figure 9.7 polar angular distributions are shown for the Pb/Ag(100) surface with different Fe coverages. The Ar/Pb yield is depicted in the graphs on the left side, whereas the Ar/Ag yield (solid lines) and the Ar/Fe yield (dashed line) are shown in the graphs on the right side. Note that for these scans the scale is the same for all three contributions.

For the clean Pb/Ag(100) surface, the Ar/Pb yield increases as a function of increasing polar exit angle, but does not show a sharp focusing feature. This is explained by the fact that the distance between the Pb atoms in the [011] direction are different for the two different domains. The Ar/Ag yield is of the same order of magnitude but the increase in the yield appears to be much sharper. This is caused by focusing of the Ar+ ions on the underlying Ag layer by rows of Pb atoms in the top layer. These rows are part of the domains with the close-packed Pb rows parallel to the [011] direction of the Ag(100) surface. These Pb atoms also focus the scattered ions in the direction of the detector.

After deposition of 1.0 ML of Fe, the Ar/Pb yield increases at lower exit angles, whereas the for larger exit angles the yield decreases. This indicates that the number of steps on the surface increases and that the number of Pb atoms having a nearest-neighbour in the close packed rows diminishes. This also results in a decrease of the Ar/Ag yield, since the focusing by the Pb atoms is less effective. Note that the Ar/Ag yield is much larger than the Ar/Fe yield, indicating that the underlying layer consists primarily of Ag atoms. After further deposition of Fe (up to 10 ML), the angular distributions show that the surface has become even rougher. Moreover, the Ar/Fe yield has increased with respect to the Ar/Ag yield, showing that the amount of Fe in the two outermost surface layers increases. For this case, the number of Fe, Ag and Pb atoms in the outermost layers is of comparable magnitude.

9.4 Summary and conclusions

In this chapter the evolution of the structure of thin Fe layers during growth on a Pb/Ag(100) surface is described. The 1.0 ML thick Pb overlayer shows a (6 × 2) reconstruction in two different domains as measured with low-energy electron diffraction (LEED). This is explained by a compressed hcp Pb overlayer with a so-called Ag(100)-c(6 × 2) moiré structure. The structure was confirmed in LEIS-TOF experiments by measuring the angular distribution of scattered Ar+ ions.
Figure 9.7: Polar angular distributions of 5.0 keV \( \text{Ar}^+ \) ions scattered from a Pb/Ag(100) surface after deposition of 0 ML of Fe (top), 1.0 ML of Fe (middle) and 10 ML of Fe (bottom). The total scattering angle was 55° and the scattering plane corresponded to the (011) plane of the Ag(100) substrate. The Ar yield scattered from Pb atoms is shown in the graphs on the left side, whereas the Ar yield scattered from Ag atoms (solid lines) and from Fe atoms (dashed lines) is shown on the right side.
The growth of the Fe layers was monitored by measuring the yield of specular reflected 5.0 keV Ar$^+$ ions at a scattering angle of 6°. From the continuous decrease in the yield it was concluded that the growing surface became rough on a length scale of less than 12 interatomic distances. This observation was confirmed by azimuthal as well as polar angular distributions of scattered Ar$^+$ ions in LEIS-TOF experiments. These experiments also showed that the Pb overlayers effectively float on top of the growing Fe layer, almost completely covering the surface, even after deposition of 10 ML of Fe. After the growth of 1.0 ML of Fe, the layer underneath the Pb layer consists primarily of Ag atoms. The reconstruction of the Pb overlayers has vanished, and the Pb atoms adopt more or less the structure of the underlying Ag layer. Upon further deposition of Fe, more Fe atoms were observed in the two outermost surface layers. The surface may be inhomogeneous on a small length scale, with three-dimensional clusters of Fe not covered by the Pb (and Ag) layer. Further investigation with other techniques, such as STM and TEM is needed to resolve the obtained structure.