X-ray reflectometry at interfaces

Because of the technological progress computer systems of minimalistic size can be produced, which can't be investigated by ordinary light microscopes. Therefore a special technique is necessary to have a look at morphological changes during the use of these systems.

The x-ray reflectometry allows us to explore magnitudes down to angstroms in bulk solid matter and in thin liquid films as well. The sample has to be carefully deposited in the x-ray beam. With the aid of a detector, which stands at the angle of Bragg reflexion, the scattered intensity is perceived. As the information exists in impulse space the Fourier transform plays an important role in the data analysis.

The Born approximation is used to find a simple resolution, where the intensity depends on the derivative of the electron density of the investigated system. For exact physical quantities the Fresnel formalism leads to elaborate formulae.

By then considering some layer systems with roughness and thickness important coherences can be understood. For example the contrast between two layers defines the characteristic of the oscillation and every distance in a sample determines the frequency to be seen in the scattered intensity.

As mentioned above technical systems are regularly analyzed and so the x-ray reflectometry is applied on a thin gold layer sandwiched between two polystyrene matrices deposited on silicon substrate. The system in this experiment is illuminated several times during annealing, which simulates the use of an integrated circuit.

Both theory and experimental techniques are illustrated in the following presentation.

References

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