**Ultra-Fast Time Resolved Electron Diffraction at Surfaces**

S. Möllenbeck, A. Hanisch, T. Pelka, P. Schneider, B. Krenzer, M. Horn-von Hoegen

---

**Thin Films**

Thin Bi-films on Si(111) and Si(111) have been investigated.

On Si(001) two different treatments were used:
- a) Bi deposition on Si(001)-(c4x2) at 300 K.
- b) Bi deposition (2.8 nm) on Si(001) at 150 K annealed at 420 K and additional deposition at 400 K.

**Acoustic Mismatch Model**

The transmission probability can be calculated by a theoretical formula. Within phonons are described as elastic waves. In analogy to optics the “Fresnel”-equations or “Snells Law” can be used to describe total internal reflection of the phonons at the interface. Due to the large difference in the speed of sounds only a small amount of phonons can cross the interface.

**Thickness Dependence**

Using the thickness dependence of the decay constant $\tau_c$, we can compare the theoretical Thermal Boundary Conductance of the AWM (calculated using bulk values) with the experimental result.

---

**Measurement**

After heating the sample the intensity of the diffraction pattern decreases. The intensity decay is converted in a surface temperature measured by using the Dwyer-Effekt. The surface temperature decay depends on the sample's heat diffusion and can be determined in a static experiment.

The transient temperature evolution shows three different regions. They all can be well described by one empirical fit function.

---

**Monolayers Lead (Debye Waller)**

This Pb film was prepared on Si(001)-(7x7) at 100 K and slowly annealed to RT. By deposition at 500 K, the coverage was reduced to a coverage of 1 ML. The (4x1) islands form a barrier for thermal diffusion.

---

**Clean Silicon**

The order-disorder transition from Si(001)-(c4x2) to (2x1) was investigated.

After flash annealing the sample at 500 K a clear c(4x2) can be observed. Faster preliminary results are shown here. The intensity drops by 4% upon excitation. The intensity of the c(4x2) diffraction spots recover slowly with a time constant of several hundred ps.

These results agree surprisingly well with literature values on the excitation of the electron system.