**Our Messages**

**Far-infrared ellipsometry:**
The far-infrared dielectric function of spontaneously (partially) CuPt-ordered AlGaInP has tensor character.

**Observation:**
Ternary and quaternary III-V semiconductor alloys (here: AlGaInP) have in-active lattice modes with small polarity which can not assigned to the binary components.

**Conjecture:**
Locally the bonding relationship (segregation, partial local ordering) fluctuates and induces lattice modes of small polarity (alloy-induced modes: AM) in the alloy.

**Evidence:**
The alloy-induced modes show an increasing directional response (anisotropy, transition to CuPt symmetry) and polarity (TO-LO splitting) with increasing degree of ordering.

**Experiment**
The phonon modes with A_1 and E-symmetry in quaternary CuPt-ordered (Al,Ga)_{1-x}In_xP with 0 ≤ x ≤ 1 are determined employing far-infrared-spectroscopic ellipsometry (FIR-SE).

Frequencies of the local modes AM and AM frequencies observed in spontaneously CuPt-ordered GaInP, (~ 312 cm⁻¹ and ~ 351 cm⁻¹).

- **MOCD:**
  - CuPt ordering on (001) GaAs:
  - CuPt ordering on (001) GaAs:

- **TEM:**
  - different misorientations

- **CuPt ordering:**
  - CuPt ordering

- **UV-ellipsometry:**
  - layer thickness, band-band transitions

- **Ir-ellipsometry:**
  - phonon modes and direction dependence of phonon modes

**FIR-dielectric tensor**
- C_{ij} and C_{j}^{(h)} (parallel i, perpendicular j, to the direction of ordering)
- TO- and AM-modes are local maxima of Im(ε) (vertical solid and dotted lines)
- LO- and AM-modes are local maxima of Im(ε) (vertical solid and dotted lines)

**FIR-SE analysis**
- Phonon modes of highly disordered AlGaInP show in addition to GaP-like, InP-like, and AlP-like modes alloy induced modes
  - depends on composition
  - CuPt ordering induced splitting of modes with E and A_1 symmetry
  - degree of ordering: M. Schubert et al. (unpublished)

**Setup A:**
- Plane of incidence perpendicular to [110]

**Setup B:**
- Plane of incidence parallel to [110]

**Ga_{0.52}In_{0.48}P**

**Phonon modes**

**Setup A:**
- Two FIR-SE measurements at different sample orientations allow the determination of the anisotropic dielectric function tensor.

**Setup B:**
- Plane of incidence perpendicular to [110]

**FIR-dielectric tensor**

**Ga_{0.52}In_{0.48}P**

**Phonon modes**

**FIR-dielectric tensor**

**CuPt ordering induced FIR birefringence**

**M5.33**

T. Hofmann, V. Gottschalch, M. Schubert

1) Solid State Physics Group, Faculty of Physics and Geosciences, University of Leipzig, Germany
2) Faculty of Chemistry and Mineralogy, University of Leipzig, Germany

*E-mail: Tino.Hofmann@physik.uni-leipzig.de*