Séminaire du LCP-A2MC

(Odd) vibration extinction / activation / switch in semiconductor alloys Inelastic light (Raman) / X-ray / neutron scattering

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Due to their simple (crystal) structure and constituents (atoms), the pseudo-binary disordered $A_{1-x}B_xC$ semiconductor alloys (SCA) offer a unique playground to explore how physical properties are impacted by disorder in a percolation context. In particular, the lattice dynamics, governed by the bond force constant, *i.e.*, a local physical property, is potentially sensitive to the alloy disorder down to the atom scale where the A↔B substitution takes place.

In recent years, our group was involved in an extended study of the lattice dynamics of a series of pseudo-binary semiconductor alloys with maximum (cubic) and reduced (hexagonal) symmetry covering the whole range of possible wavelengths, from quasi infinite ones down to minimal ones of twice the lattice constant. Complementary insights at various length scales were achieved by combining in-house inelastic light (Raman) scattering together with inelastic neutron scattering (INS) and inelastic X-ray scattering (IXS) using national-size facilities (a nuclear reactor and a synchrotron, respectively). The resulting overview of the lattice dynamics of SCA, phenomenologically formalized within our generic percolation model,[1] covers not only the optical and acoustic phonon dispersions of SCA (measured by INS/IXS) but also their phonon-polariton dispersion (accessed by Raman scattering) – the latter remaining unaddressed experimentally in the literature, apart in our own contributions.

In this talk, I will review very recent Raman/INS/IXS results obtained by our group (as part of the ViSA-IRP consortium[2]) at ambient and high pressure (using a diamond anvil cell), supported by (home-made) *ab initio* phonon calculations, indicating how the A↔B substitution affects the lattice dynamics of SCA at all length scales. Particular attention is drawn to a number of disconcerting mode-activation/inversion/extinction processes depending on the used scattering geometry, or on the A-C/B-C bond mismatch, or on pressure.

[1] Alhaddad *et al*., *Sci. Rep.* **15**, 1212 (2025).
[2] https://lcp-a2mc.univ-lorraine.fr/projet-visa/

Mardi 2 décembre 2025 à 11h00

Salle de Réunion de Chimie – I.C.P.M.

1, boulevard Arago, Metz-Technopôle