

Einladung

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Seminarvortrag



Freitag, 26. Januar 2018, 12:30 Uhr

Seminarraum PHY 5.0.21

Dr. Robert LovrincicInstitut für Hochfrequenztechnik, TU Braunschweig &
InnovationLab, Heidelberg**“Vibrations in Methylammonium Lead Halide Perovskites:
Implications for Electronic Properties and Chemical Analysis”***Abstract:*

Metal-halide perovskites are promising materials for opto-electronic applications. Their mechanical and electronic properties are directly connected to the nature of their lattice vibrations. Whereas the mid infrared (IR) range contains mainly information on the internal vibrations of the methylammonium cation,¹⁻³ the lead-halide lattice vibrations are located in the far IR.

We will report far-IR spectroscopy measurements of $\text{CH}_3\text{NH}_3\text{Pb}(\text{I}/\text{Br}/\text{Cl})_3$ thin films and single crystals at room temperature and a detailed quantitative analysis of the spectra.⁴ We find strong broadening and anharmonicity of the lattice vibrations for all three halide perovskites. We determine for the first time the frequencies of both the transversal and longitudinal optical phonons, and use them to calculate the static dielectric constants, polaron masses, and upper limits for the phonon-scattering limited charge carrier mobilities.

We will show how mid-IR spectra can be used to determine the exact stoichiometry of MAPbX_3 films. Furthermore, we will demonstrate how the impact of external stimuli can be tracked with mid-IR spectroscopy and correlated to electronic properties. We recently found that water can infiltrate methylammonium lead iodide with surprising ease.³ This infiltration has a strong impact on the opto-electronic properties of the material, possibly via photochemical processes, as demonstrated by measuring the change of photocurrent in lateral devices.

References:

- (1) Glaser, T.; Müller, C.; Sendner, M.; Krekeler, C.; Semonin, O. E.; Hull, T. D.; Yaffe, O.; Owen, J. S.; Kowalsky, W.; Pucci, A.; Lovrincic, R. Infrared Spectroscopic Study of Vibrational Modes in Methylammonium Lead Halide Perovskites. *J. Phys. Chem. Lett.* 2015, 6 (15), 2913–2918.
- (2) Bakulin, A. A.; Selig, O.; Bakker, H. J.; Rezus, Y. L. A.; Müller, C.; Glaser, T.; Lovrincic, R.; Sun, Z.; Chen, Z.; Walsh, A.; Frost, J. M.; Jansen, T. L. C. Real-Time Observation of Organic Cation Reorientation in Methylammonium Lead Iodide Perovskites. *J. Phys. Chem. Lett.* 2015, 6 (18), 3663–3669.
- (3) Müller, C.; Glaser, T.; Plogmeyer, M.; Sendner, M.; Döring, S.; Bakulin, A. A.; Brzuska, C.; Scheer, R.; Pshenichnikov, M. S.; Kowalsky, W.; Pucci, A.; Lovrincic, R. Water Infiltration in Methylammonium Lead Iodide Perovskite: Fast and Inconspicuous. *Chem. Mater.* 2015, 27 (22), 7835–7841.
- (4) Sendner, M.; Nayak, P. K.; Egger, D. A.; Beck, S.; Müller, C.; Epding, B.; Kowalsky, W.; Kronik, L.; Snaith, H. J.; Pucci, A.; Lovrincic, R. Optical Phonons in Methylammonium Lead Halide Perovskites and Implications for Charge Transport. *Mater Horiz* 2016, 3 (6), 613–620.

Gastgeber: Dr. David Egger; *Achtung: neue Anfangszeit ist 12:30 Uhr!*