Spectroscopy of 2D materials at cryogenic temperatures

Remo Tietze, **Alexander Eychmüller**

Physical Chemistry, Dresden University of Technology, Dresden, Germany

Semiconductor nanoplatelets are a novel class of 2-dimensional materials with a broad application field in biomedical imaging and light-emitting devices. The thickness of these platelets can range from a few micrometers to a few atomic layers. Hereby it is outstanding that the number of layers, which are forming the material are determining the photoluminescence energy. Furthermore, their narrow emission spectrum with a fwhm of less than 40 meV and short emission lifetimes are making them prominent for lasing applications.[1] The research field of interest is the cryogenic spectroscopy of this fascinating materials, as a thorough characterization is helping to optimize desirable specifications of devices. An investigation at low temperatures is useful to clarify the electronic structure, impurities and the role of trap-states in the material.[2] Moreover, the behavior of charge carriers can be understood better when it is coming to more complex structures such as core/crown, core/crown/shell or core/shell nanoplatelets. In detail, the materials are characterized by the measurement of their photoluminescence, excitation and lifetime behavior in a range from 300 to 10 K. Hereby we notified for nanoplatelets of different thicknesses a dependence on the photoluminescence shift with increasing temperature. Not only well known materials (e.g. CdSe, CdS) but also cation exchanged ones like HgSe, which are showing superior properties in the NIR, are examined.

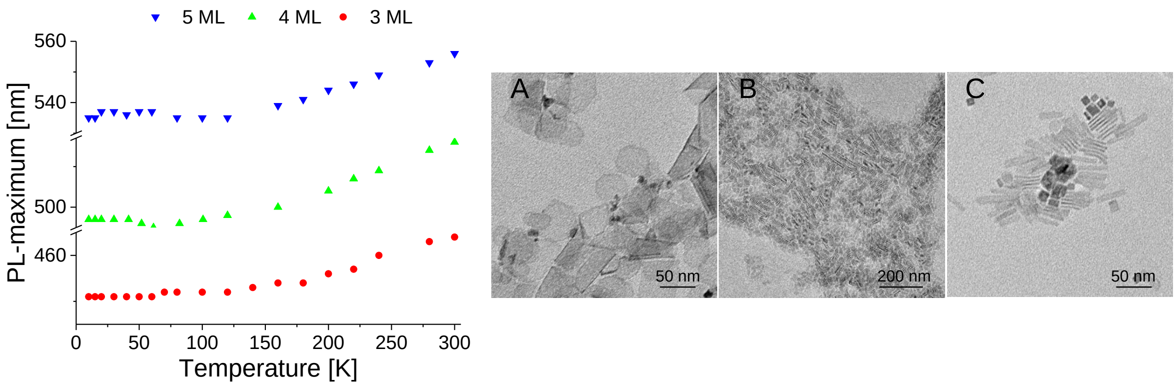

Fig 1 PL-maximum shift in dependence of the temperature for CdSe nanoplatelets with 3, 4 and 5 monolayers thickness. Moreover, TEM-images of these synthesized nanoplatelets can be seen 3ML (A), 4ML (B) and 5ML (C).

References:

1) Ithurria, S., Tessier, M. D., Mahler, B., Lobo, R. P. S. M., Dubertret, B., Efros, A. L. Colloidal nanoplatelets with two-dimensional electronic structure. *Nature Materials*, **2011** *10*(12), 936–41.

2) Jonscher, A. K. Semiconductors at cryogenic temperatures. *Proceedings of the IEEE* **1964**, *52*(10), 1092–1104.