1.1. Project goals: The aim of this project is to investigate experimentally and theoretically heat propagation in both direction (perpendicular and parallel) to the surface of polymer nanolayers.

1.2. Outline :

In this project two research area are planned: possible new findings on the physical understanding of heat transport in thin organic films and in terms of the technical implementation of Oleds or organic solar cells. The combination of photothermal infrared radiometry and thermoreflectance measurement method in temperature range -200 C to 420 C allows to quantify how the thickness of a nanofilm affects its ability to conduct heat in different directions [1,2]. Nanofilms are usually anisotropic on their thermal properties. The process of heat conduction is important in optoelectronic and photonic devices, where the polymer is one of the components. It should be mentioned that thermal management is important for the efficient operation of organic light-emitting diodes (OLEDs). Excess heat in OLEDs that is produced during their operation may accelerate their degradation and may cause an inhomogeneous brightness distribution, in particular in large area OLEDs. Assessing the quantitative impact of heat excess is difficult, because all decisive processes related to charge transport and emission via charge recombination are thermally activated. Decisive for OLED are the thermal effects that occur in the device layers outside the electrically active area. Therefore, the aim of the PhD thesis will be to focus on the parameters responsible for heat transport in the polymer, i.e. the thermal conductivity and the heat transfer coefficient. The heat transfer to the ambient environment is the key parameter to dissipate excess heat from the device. Moreover, it is worth to emphasis that the contribution of the layer and boundary resistance can be easily distiqwish using thermal wave methods [3].

1.3. Work plan

1) growth of the polymer nanolayer samples with different thickness,
2) measurement of perpendicular and parallel to surface thermal transport properties of polymer nanolayer samples
3) theoretical prediction of thermal conductivity in polymer nanolayer samples

1.4. Literature:

[1] M. Pawlak, N. Jukam, T. Kruck, D. Dziczek, A. Ludwig, A.D. Wieck, Measurement of thermal transport properties of selected superlattice and thin films using frequency-domain photothermal infrared radiometry, Measurement **166** (2020), 108226

[2] M. Pawlak, T. Kruck, D. Dziczek, A. Ludwig, A.D. Wieck, Experimental validation of formulas of calculating some thermal transport properties in superlattice performed using combination of two frequency-domain methods: photothermal infrared radiometry and thermoreflectance, under review

[3] M. Pawlak, N. Horny, S.Scholz, C.Ebler, A.Ludwig, A.D.Wieck, "Simultaneous measurement of infrared absorption coefficient of Carbon doped Al0.33Ga0.67As thin film and thermal boundary resistance between thin film and heavily Zn doped GaAs using spectrally-resolved modulated photothermal infrared radiometry",THERMOCHIM ACTA **667** (2018), 73-78

1.5. Required initial knowledge and skills of the PhD candidate

The candidate is expected to have a theoretical background in solid state physics on academic level, as well as to have sufficient expertise in data analysis. Some programming skills (preferably Python or Matlab) are necessary. Basic knowledge in electronics is also desired, since the student will carry on measurements using various experimental setups, all of them full of electronic items and devices.

1.6. Expected development of the PhD candidate's knowledge and skills

The student will be participated in Team of Measurement Systems in the frame of Emerging Field Automatization and control systems. It allows student to apply for a lot of opportunities to visit other research teams (Canada, Germany, Slovenia, Italy, France). The student will master several experimental techniques used to study thermal and electrical anisotropy of superlattice, as well as he/she will learn the fundamentals of heat propagation in this materials. He/she will improve his/her skills in programming, data analysis and drawing conclusions from data.