第114回　OPERA研究交流セミナー
第106回　ISIT有機光エレクトロニクス研究特別室セミナー
第173回　未来化学創造センターセミナー

日時：　2014年8月4日(月)　16:00-

場所：九州大学　最先端有機光エレクトロニクス研究棟　3F会議室

“ Emitter orientation as promising concept for efficiency increase in OLEDs ”

Tobias D. Schmidt

Institute of Physics, University of Augsburg, 86135 Augsburg, Germany

Organic light-emitting diodes (OLEDs) are promising large-area light sources on their way to commercialization. However, there is still much room for improvement in terms of light outcoupling efficiency and long-term stability under electrical operation.
The external quantum efficiency (EQE) of OLEDs is significantly less than 100% since only a small fraction of the consumed electrical power is converted into visible light that is finally extracted to air. Most of the efficiency is lost due to suboptimal radiative quantum efficiency (RQE) of the emitting guest-host system and by dissipating a huge part of the radiated energy to optical loss channels such as surface plasmons or waveguided modes, which cannot easily be extracted by common outcoupling methods. In order to increase the EQE of OLEDs new approaches are needed.
Recent studies show that light outcoupling can be enhanced considerably by a horizontal orientation of the emitter's transition dipole moments; a feature that is well known for fluorescent emitters and has lately been demonstrated in phosphorescent state-of-the-art OLEDs. We identify non-isotropic emitter orientation by a thorough efficiency analysis of OLED stacks with systematically varied thickness. We show that in order to achieve a consistent analysis, it is indispensable to account for possible deviations from randomness. Ignoring these orientation effects leads to a significant misinterpretation of the RQE and other factors, which determine the EQE of a device. Furthermore, state-of-the art emitter-matrix combinations will be used to demonstrate the potential for improving the efficiency of OLEDs in this way. Moreover, thermally activated delayed fluorescence is a promising approach for tailoring emitting molecules in the whole color range, especially for deep blue emission, which is still a huge problem for phosphorescent dyes. With this concept, the radiative exciton fraction of this new emitter class can probably even reach the value of phosphorescent emitters.
Additionally, a strong horizontal orientation of the emissive dipole moments of the molecules, which could be achieved by the typical rod-like shape of these emitting molecules, can increase the outcoupling efficiency further and hence these emitters have the potential to become even more efficient than their phosphorescent counterparts .
Furthermore, a new concept for determining the emitter orientation using simple external quantum efficiency measurements will be presented.

主催：九州大学　最先端有機光エレクトロニクス研究センター
：財団法人九州先端科学技術研究所(ISIT)
共催：九州大学　未来化学創造センター