Organic Optoelectronics – A Matured Technology or still a Field of Basic Research

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Since the demonstration of low voltage driven organic light emitting devices (OLEDs) based on small molecules by Tang and van Slyke in1987 and on polymers by Burroughes in 1990 the field of organic optoelectronics is in the focus of basic and applied research. It attracts worldwide industrial attention since it addresses high volume markets like displays, lighting, and renewable energies. The growing number of product announcements consolidates the impression that the technology has matured within the last two decades and that there is now further need for extensive basic research.
In this talk we will discuss two fields of applications of organic optoelectronics: OLEDs for lighting and organic photovoltaics. After a brief introduction in the device structures and performance exemplarily two topics will be addressed to point out that the need of basic research is not declining but on the contrary will further increase.
Discussing stacked OLEDs for lighting applications will show up the need of high p- and n-type doping levels in organic semiconductors. But the discussion of the experimental data will indicate that the doping efficiency is extremely low. The reasons for this unexplained phenomenon will be illuminated by a detailed look on the morphology.
Organic photovoltaics suffers from low efficiencies despite the high extinction coefficients of organic chromophores promise efficient light conversion. Again a detailed analysis of exciton diffusion, charge separation, and transport gives first hints on the phenomena limiting dramatically the efficiency.

GaN Nanowires – growth, optical properties and the route towards LED applications

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We are investigating GaN nanowires both, to study the underlying growth processes and to test their potential as building blocks for nanoscale devices. In this talk I will discuss group-III nitride nanowires with respect to their possible impact on realising high quality material on Si, in particular for LED applications.
We grow such nanowires by molecular beam epitaxy (MBE) on bare Si surfaces without any aid by prestructuring or coverage by foreign materials. I will at first illustrate the factors that govern the nucleation process and the formation of the initial nanowire diameter on Si.
In order to assess the usefulness of such structures, some results on structural and luminescence properties will be presented. They will illustrate that despite the high surface-to-volume ratio, the luminescence of GaN nanowires can be very efficient, but also shows some features that are unusual compared to planar GaN layers.
In order to prepare test devices, we have grown p-i-n structures and processed these into arrays of LEDs and I will show results on electroluminescence as well as an analysis of their efficiency.

Looking into the future, it has to be questioned if the statistical nucleation process can be sufficiently controlled in order to lead to a viable technology. To address this issue, I will present some promising results of our efforts to achieve a controlled positioning of GaN nanowires by selective area growth.