Self-Organized Materials for Optoelectronic Applications

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Investigating materials for optoelectronic applications under the special focus of self-organization is very fascinating as it combines research on materials with high importance for modern society such as optical displays (LCD or OLED), plastic electronics, or organic photovoltaics with fundamental questions on basic natural science. The aspect of self-organized structures is particularly attractive, because self-organization enables the formation and optimization of highly ordered and/or oriented structures to maximize desired optoelectronic properties. This is hardly possible with randomly structured materials. In this context, liquid crystalline phases and block copolymers can be used to obtain the desired functions. In addition, interfacial phenomena play a critical role and underlie the most relevant device characteristics.

Such an interdisciplinary topic, which covers areas from (i) the synthesis of new materials, over (ii) the modelling and (iii) the control of their superstructure to their (iv) optoelectronic characterization can—naturally—be only worked on by researchers with expertise ranging from synthetic chemistry to theoretical physics and device engineering. Therefore, wide interdisciplinary and international perspective is an essential requirement to successfully elaborate such a topic. The framework of the "International Research Training Group, IRTG 1404" jointly funded by the DFG (Germany, GRK 1404) and KOSEF/NRF (South Korea) represents such an international cooperation.

In this special issue, we assemble recent work on this topic—selected during a strict reviewing process—within several reviews and a feature article. The feature article summarizes the joint work in the area of "Energy and Charge Transfer in Nanoscale Hybrid Materials".[1] As hybrids from inorganic and organic materials become more and more important for this topic, ways for their preparation and, particularly, morphology control are described in the second review.[2] Additionally, three reviews describe materials for optoelectronics[3] and the topic of charge transport,[4,5] which is most essential for all the devices introduced in this special issue. As a result, the topic of charge transport is split into two reviews, which focus on a special polymeric system[4] or discuss more generally the influence of doping.[5]

The "International Research Training Group: Self-Organized Materials for Optoelectronics" (IRTG 1404) (see: http://www.opto-electronics.chemie.uni-mainz.de), in which much of this work was done, started in October 2006 and combined—over time—12 to 15 principal investigators (PIs) from the Johannes Gutenberg University (JOGU) and the MPI for Polymer Research (both Mainz, Germany) and 8–10 PIs from the Seoul National University (SNU) and the Hannam University (both South Korea). Over the nine years of its existence, over 40 German PhD students and about 20 Korean PhD students finished their PhD thesis in this international context, doing part of their research work in laboratories in the partner countries.

This rigorous IRTG student exchange led to combined PhD

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theses between the University of Mainz and the Seoul National University, such that 14 students were granted PhD documents up to now, which bear the signs of both universities. Besides this student exchange, there were also very active exchanges among faculty members from both countries, for example, by participating in the WCU Program at the Seoul National University (Dr. habil. Patrick Theato from Mainz, now a professor at the University of Hamburg) and by nominating a Korean professor (Kookheon Char) as the fellow of the Gutenberg Research College at the University of Mainz for 3 years.

The collected communications and the critical overview articles combined in this special issue are a clear sign of how the IRTG contributed to the timely topic of self-organized materials for optoelectronic applications. Enjoy reading!

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