Hybrid Inorganic/Organic Systems for Opto-Electronics

Collaborative Research Centre 951

Colloquium Announcement

of the Collaborative Research Centre 951
"Hybrid Inorganic/Organic Systems for Opto-Electronics"

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Efficient single-layer organic light-emitting diodes with balanced charge transport

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Charge Transfer Mechanisms at TMDC/Organic Hybrid Interfaces

Time: Thursday, 27.05.2021, 15:15

Place: The colloquium takes place online (ZOOM)

Meeting-ID: 645 8806 9997
Password: 951951

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Efficient single-layer organic light-emitting diodes with balanced charge transport

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Organic semiconductors are used in optoelectronic devices, such as organic light-emitting diodes, organic and perovskite solar cells, and organic field-effect transistors. The performance of such devices depends heavily on charge injection and transport. In many cases, organic semiconductors exhibit highly unipolar charge transport, meaning that they predominantly conduct either electrons or holes. A fundamental question is what causes this unipolarity. We demonstrate that an energetic window exists inside which organic semiconductors are not susceptible to charge trapping by water or oxygen, leading to trap-free charge transport of both carriers. The implication for devices such as OLEDs, organic solar cells and organic ambipolar transistors is that the energy levels of the organic semiconductors are ideally situated within this energetic window. However, for blue-emitting OLEDs with a large band gap this poses significant challenge to remove or disable charge traps.

Charge Transfer Mechanisms at TMDC/Organic Hybrid Interfaces

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Two-dimensional transition metal chalcogenides (TMDCs) exhibit excellent optical properties. This motivates recent efforts to combine TMDCs with organic semiconductors. Here, we present the results of steady state and transient optical studies of monolayers of TMDCs interfaced with organic hole transport materials. By performing steady state photoluminescence (PL) and ultrafast transient absorption spectroscopy (TAS) on the neat TMDC and the hybrid TMDC/organic stack, we find that the dynamics of the TMDC excitons is largely governed by the fast trapping and recombination of charges on the MoS2 layer while the transient properties of the hybrid bilayer are dominated by a long-lived signal which we assign to photoinduced hole transfer. Measurements as function of laser fluence reveal a first order interfacial recombination process, indicating that the photoinduced charge transfer forms bound electron-hole pairs. Finally, we present results of preparatory work on the non-fullerene acceptor Y6 - a promising new organic molecule to be combined with "donor-type" TMDCs such as WSe_2.