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Adaptive Wetting and Actuating Devices based on Conducting Polymer Materials

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Conducting polymers (CPs) are discussed in a huge variety of electronic devices including organic field effect transistors, batteries, actuators and (bio)electronic sensors. Compared to other conducting materials, CPs are light-weight, low cost, non-toxic, flexible and allow easy processing, low voltage operation (around 1 Volt) and low power consumption.
Here, poly(3-hexylthiophene) (P3HT) and poly(3,4-ethylenedioxythiophene):poly(styrene sulfonate) (PEDOT:PSS) are presented as work-horses of our team due to their high conductivities and electrochromism which can be accessed by tailor-made doping. The doping states of these semiconductors can be controlled by electrochemical or chemical doping. A former study in our team showed that for P3HT an increase in conductivity over 6 orders of magnitude can be obtained as function of increasing electrochemical doping potential, giving maximum conductivities as high as 200 S/cm.1 Currently, we are working on using this electrochemical doping strategy to induce changes in chemical and physical properties of P3HT and PEDOT:PSS. Particularly interesting for the priority program SPP-2171 is our finding that also the wettability and the water uptake (sorption) dramatically change as function of the doping level.
Due to the fact that PEDOT:PSS is a mixed conductor, it also strongly depends on the relative humidity (r.H.) which makes it possible to build humidity-responsive bilayer actuators.2 The curvature of such humidity-triggered actuators can be explained by a combined study of rheology including wetting and water uptake studies

References

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(2) C. Dingler, H. Müller, M. Wieland, D. Fauser, H. Steeb, S. Ludwigs, Adv. Mater., **2021**, 33, 2007982.

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