ALEXANDER SCHILLER

JUNIOR PROFESSOR OF PHOTONIC MATERIALS, INSTITUTE FOR INORGANIC AND ANALYTICAL CHEMISTRY

Dr. Schiller holds a Junior Professor position for photonic materials from the Carl Zeiss foundation (2009-2013). He is involved in the DFG research unit HHDP (Heme and Heme Degradation Products, FOR 1738, 2012-2015), in the FP7 project NOVOSIDES (2010-2014) and in the FP7 coordination action COBRA. He is a member of the Abbe Center of Photonics, Center of Medical Optics and Photonics, and Jena Center for Soft Matter. Dr. Schiller is president of the local union of the German Chemical Society (GDCh). He is an associate editor of the journal Reviews in Inorganic Chemistry.

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RESEARCH AREAS

In his research Dr. Schiller focuses on molecular, supra- and biomolecular information processing via the interaction of matter and light. He uses techniques from materials and bioinorganic photo chemistry and supramolecular analytical chemistry. Research thrusts include:

- photo-inducible nitric oxide (NO) and carbon monoxide (CO)-releasing molecules and materials
- molecular and material logic and computing with sensors and light

TEACHING FIELDS

Dr. Schiller's teaching activities involve inorganic chemistry courses for Bachelor degree, Master's degree and student teachers. He gives lectures in:

- supramolecular inorganic chemistry
- inorganic analytical chemistry
- research skill development and introduction into academic teaching (together with PD Dr. Daniel Mertens, University Hospital Ulm and DKFZ Heidelberg)

RESEARCH METHODS

The laboratories led by Dr. Schiller offer possibilities for advanced synthesis of small molecules and polymer materials. The following analytical methods and equipment are utilized and available in his laboratories:

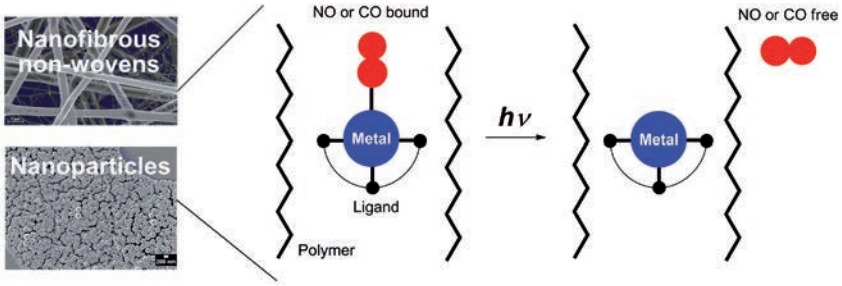
- fluorescence and UV-Vis spectroscopy with a Varioskan plate reader (Thermo Fisher) and a Specord S 600 (Analytik Jena)
- electrochemical detection of nitric oxide (NO) and carbon monoxide (CO)

RECENT RESEARCH RESULTS

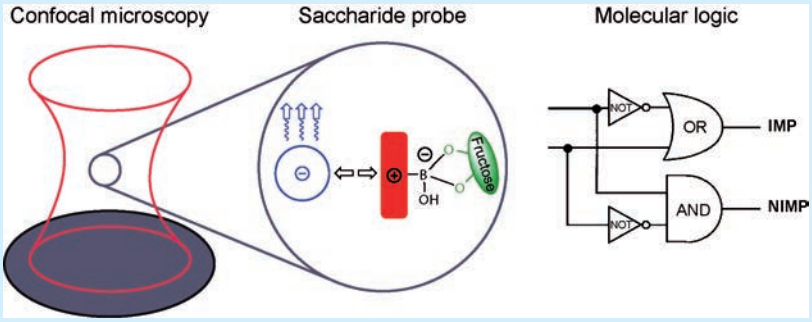
The Schiller group developed in collaboration the concept of embedding water-insoluble, photoactive nitrosyl and carbonyl metal complexes into nanoparticles and fibrous polymer non-wovens [1-3]. Nitric oxide (NO) and carbon monoxide (CO) released into the surrounding medium is performed via light stimulation of the high surface area materials. NO and CO act as important messenger molecules in the human body. NO and CO releasing materials (NORMAs & CORMAs) are important for the development of safe gasotransmitter delivering devices for therapeutic purposes; toxic metabolites after gas release are kept in the biocompatible polymer matrix. NO and CO photodonors use light as a convenient non-invasive on/off trigger since they allow the accurate control of site, timing and dosage [4].

Furthermore, the Schiller group uses a two-component sensing concept based on anionic fluorescent dyes as reporters, and boronic acid-appended bipyridinium salts as receptors. Analyte targets are sugars, nucleotides and anions in water. In addition, real-time label-free fluorescent enzyme assays have been developed for sucrose phosphorylase, phosphoglucomutase and β-glucosidase [5]. The assays are suitable for high-throughput screening of novel carbohydrate enzymes for industrial applications [6].

[1] BOHLENDER ET AL., J. MATER. CHEM. 22, 8785 (2012).
[2] CRESPY ET AL., CHEM. COMMUN. 46, 6651 (2010).
[3] BOHLENDER ET AL., PART. PART. SYST. CHARACT. 30, 138 (2012).
[4] WYRWA ET AL., PATENT DE10 2012 004 132.2 (2012).
[5] SCHILLER, IN MOLECULES AT WORK. SELFASSEMBLY, NANOMATERIALS,
MOLECULAR MACHINERY, WILEY-VCH, 315 (2012).
[6] DESMET ET AL., CHEM. EUR. J. 18, 10786 (2012).



MOLECULAR LOGIC WITH A SACCHARIDE PROBE ON THE FEW-MOLECULE LEVEL



Together with Carl Zeiss Microscopy and the assistance of Prof. Müllen (MPI for Polymer Research, Mainz), the Schiller group could describe a molecular sensor that can perform a logical function called IMP ("implication"). Such a gate was implemented using a fluorescent dye, water-soluble perylenediimide (WS-PDI) and a boronic acid-containing viologen BBV as one input. The second input is fructose. They monitored the reaction using fluorescence correlation spectroscopy on a confocal microscope on the few-molecule level of the fluorescent dye. The result is both a logic circuit and a sugar sensor. This work demonstrates ways by which Boolean logic can process information in the field of sugar diagnostics and was highlighted as JACS Spotlight [Elstner et al., J. Am. Chem. Soc. 134, 8098 (2012) and Perkel, J. Am. Chem. Soc. 134, 9535 (2012)]. Currently, the Schiller group is working on the implementation of the IMP logic into molecular computing on microwell plates and on microfluidic devices.