2D Covalent Thin Films for Light-Induced Energy Conversion

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The interest in metal-free materials has been recently rising, and structures with target properties and chemical features have significantly widened the application spectrum of this class of materials. Among those, carbon nitride materials, a class of 2D polymeric semiconductor with ideal formula C_3N_4, have recently attracted much attention especially in photocatalysis. However, up to now, their application in several fields was hindered due to the low homogeneity of the coatings available. Recently, we developed an innovative method to produce carbon nitride thin films with tunable thickness by means of chemical vapor deposition. The as prepared thin films are highly stable, homogeneous, and flat with a very high refractive index, even in the range of diamond. [1] The high homogeneity and conformal deposition of the carbon nitride thin films prepared enabled to use them to develop innovative batch and microfluidic photoreactors, by coating the reactors' walls, achieving high selectivity and conversion in shorter time. [2] The utilization of carbon nitride thin films further enabled the development of in-operando spectroscopic techniques providing fundamental mechanistic insights and the critical role of surface interactions in key reactions, such as water splitting.[3, 4] Furthermore, the surface activity of carbon nitride thin films enabled to develop a system for the directional and selective movement of emulsion Janus droplets.[5] Eventually, the use of thin films in energy conversion is still in its infancy, however, it sets the premises for significant improvements in photo-, photoelectro-catalysis, and beyond.

References

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Biosketch – Dr. Paolo Giusto

Paolo Giusto pursued his Ph.D. in Polymer Chemistry at the Max Planck Institute of Colloids and Interfaces, Colloid Chemistry department, in Potsdam under the supervision of Prof. Antonietti. After graduating in 2020 and a brief postdoc, he was promoted in 2021 to Group Leader at the same institute, where he currently leads the 2D Covalent Thin Films group. Paolo Giusto's research focuses on the synthesis of covalent materials and thin films with specific chemical, electronic, and structural properties for applications in energy storage and conversion. In his position, Paolo has been awarded 5 independent grants at national and international level (MSCA-DN, DFG, EIC, DFG-NSERC). Recently, he has also been invited as a Visiting Fellow in the department of Chemical Engineering at UNSW Sydney, where he joined the group of Prof. Liming Dai and he currently holds a guest Assistant Professor position at QUT in Brisbane. While building his group he also undertook a M.B.A. at ESMT Berlin which he completed in 2023 and he is currently pursuing the German Habilitation at the Humboldt University of Berlin (with Prof. Hans Börner).