PhotoDark - Photocatalytic Reactions Under Light and Dark Using Transient Supramolecular Assemblies

The efficient conversion of solar energy into molecular fuels has been recognized as one of the grand challenges facing society today. This is motivated by the urgent need to develop affordable, reliable, sustainable modern energy as a way to address the problems arising from the burning of fossil fuels and global warming. Rapid progress is being made in the development of photocatalytic systems that use directly solar light to produce fuels but do so only during daylight. This is a significant oversight, as the overall processes are inefficient due to the intermittent nature of the solar energy source. The next frontier in energy conversion, and the key objective of my proposal, are smart materials that perform photocatalysis under irradiation and, in addition, can trap and concentrate (sun)light to then use it for catalysis under low or no illumination. To achieve this ambitious goal, TENEBRIS aims to develop an unprecedented strategy to enable dark or persistent photocatalysis by using self-assembled materials. TENEBRIS will (i) provide missing insights into light-driven supramolecular polymerization, (ii) deliver smart, autonomous and transient self-assembled materials that perform photocatalysis also under dark, and (iii) establish design principles to be generally applicable for tailor-made (nano)materials with functions unattainable through conventional methods. The fundamental outcomes of this research will lead to non-incremental advances in various chemical research areas (photocatalysis, out-of-equilibrium supramolecular chemistry, and materials science and engineering) and to a substantial impact beyond them.

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