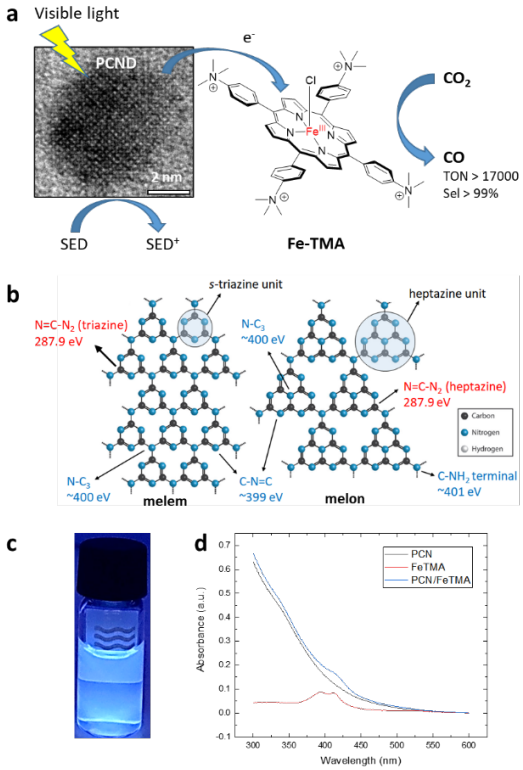
MASTER THESIS PROJECT Physical chemistry/Materials chemistry

Photocatalytic conversion of CO_2 to useful chemicals

One of the key challenges for society today is to find **sustainable ways to produce fuels and high value chemicals**. This could be transforming CO_2 to CH_4 or CH_3OH or N_2 to NH_3. For these reactions to occur high energy barriers must be overcome, and even more significant, they also require transfer of several electrons in a single reaction to form the desired products. Visible light-driven conversion of CO_2 to more value-added products is an interesting technology not only for diminution of CO_2 emissions but also for solar energy storage in the form of chemical energy. However, photocatalytic materials that can efficiently and selectively reduce CO_2 to CO in a fully aqueous solution are extremely rare, and most of them still involve precious metals that are not suitable for mass production.



Here we work with a novel water-soluble photocatalytic assembly consisting of polymeric carbon nitride dots (**PCNDs**) as the visible light absorber and a Fe-porphyrin complex (**Fe-TMA**) as the catalyst for the CO_2-to-CO conversion in fully aqueous media. Both components were carefully designed to allow for excellent solubility in water as well as improved electronic communications through electrostatic and π-π interactions. We have shown that this **PCNDs/Fe-TMA** assembly can produce CO under visible light irradiation. This is a very promising observation but in order to increase the efficiency and facilitate the formation of more useful products we need to understand the processes in detail. This include investigation of the exact mechanism of the charge transfer processes and which factors govern their rates, how shape and size of the dots affect the interaction between the different components of the assembly, which wavelengths and light intensities are most beneficial etc. We use techniques like transient absorption spectroscopy, electrochemistry, ATR and ITC and many more. Projects can be designed differently depending on the interests of the students.

Contact

Post doc Liam Mistry (mistry@chalmes.se)
Professor Maria Abrahamsson (abmaria@chalmers.se)