Photoactive hybrid thin films by molecular layer deposition

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Photoreactive surfaces can be utilized in solar cells, light sensors and photocatalytic processes for water purification systems or antimicrobial coatings. One of the promising method to design such photoactive materials is to extend the light absorption towards the visible light region by combining inorganic transition metal clusters with highly aromatic organic molecules. Molecular layer deposition (MLD) is a suitable tool to fabricate such structures with an excellent thickness control.

In this study we have produced organic-inorganic hybrid materials with photoactive properties based on 2,6-naphthalenedicarboxylic acid as the absorber and organic building unit, and Ti, Zr, Hf or Y as metal centre. We characterized the growth dynamics and physicochemical properties of our surfaces with in-situ QCM, FTIR, UV-Vis and photoluminescence (PL) measurements. The films are amorphous as deposited and prove strong photoactivity and photoluminescence. The growth dynamics is dependent on the choice of a metal and our current focus is in identifying the effect of chemistry on the growth and material properties.

In all deposited systems, the strong near-UV absorption of the organic precursor is broadened and red-shifted when the organic molecule binds to a metal atom. The PL characterization proves that the presence of different metal clusters change the optical emission of hybrid systems and moreover Ti-O clusters quench the emission from the organic linker. It was also found that the emission of light from the photoactive materials decreases upon UVC exposure, showing photobleaching effect.

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