Nanostructured Photocatalysts Prepared by Atomic Layer Deposition

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In the lecture several examples will be shown about how various nanostructured photocatalysts can be obtained by atomic layer deposition (ALD), based on our own experience. The advantage and disadvantage of ALD films on the photocatalytic activity will be discussed.

By combining electrospinning and ALD, Vis or UV active photocatalysts were prepared, e.g. WO_3/TiO_2, ZnO/TiO_2 and TiO_2/ZnO core/shell nanofibers, TiO_2 nanotubes. By using sol-gel and ALD, SiO_2/TiO_2 core/shell photocatalytic nanoparticles were obtained. Photocatalysts based on biological substrates were also manufactured by ALD, e.g. TiO_2 coated lotus leaves with both superhydrophobic and photocatalytic activities. C_{60}, graphene oxide, polymer and carbon aerogels, carbon nanospheres, PMMA nanoparticles coated with ALD ZnO, TiO2 and Al2O3 oxide layers and particles are examples for carbon and polymer nanostructure based photocatalysts.

On the previously mentioned substrates, amorphous and crystalline TiO_2, ZnO and Al_2O_3 thin films were grown by ALD at various temperatures. While TiO_2 is considered to have photocatalytic activity only in the crystalline state; unexpectedly, we observed that when TiO_2 was deposited in amorphous form on organic and biological substrates, i.e. lotus leaf, C_{60}-OH, GO, graphene oxide or PMMA, the amorphous TiO_2 layer clearly exhibited photocatalytic property.