Enantioselective Adsorption on Solid Surfaces

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Enantioselective adsorption onto solid surfaces can be taken advantage of to separate and purify the enantiomers contained in a racemic mixture,[1] and could also be the basis for the development of solid-state asymmetric heterogeneous catalysts with a potentially disrupting impact on the pharmacological industry. It is well-established now that asymmetric synthesis can only be achieved if the reactions take place within a true chiral environment.[2] The question then is to find the most effective way to achieve the appropriate chiral conditions favoring the appearance of enantiomeric excess in the reaction products.

In a first approach we make use of the CISS (chiral-induced spin selectivity) effect[3] to investigate enantiosensitive adsorption of homochiral Diphenylethylenediamine (DPEDA) molecules onto magnetic (i.e., spin-polarized) Co films epitaxially grown on Cu(100) metallic substrates. Electron spectroscopy (XPS, UPS) measurements such as those presented in Figure 1 reveal significant differences in the adsorption rate of the two enantiomers, (R,R)– and (S,S)–DPEDA onto the Co substrate, and also different electron mean free paths that can be associated to the filtering effect of the spin-polarized photoemitted electrons by the adsorbed molecular layer.[4,5]

A second strategy consists on the use of structurally chiral substrates that might produce enantioselective adsorption due to the effect of chiral recognition. For this purpose we have investigated the synthesis of hybrid organic-inorganic perovskites (HOIPs). These Pb-halide-based materials are attracting intense interest recently for their possible application for the generation of photovoltaic energy.[6] By incorporating small homochiral organic molecules into the lattice unit cell we obtain a crystalline material with a well-defined chirality in its bulk. Similar surface spectroscopic studies as those described above for the magnetic substrates demonstrate that also in this case different adsorption rates are obtained when chiral molecules are deposited onto the chiral HOIPs.

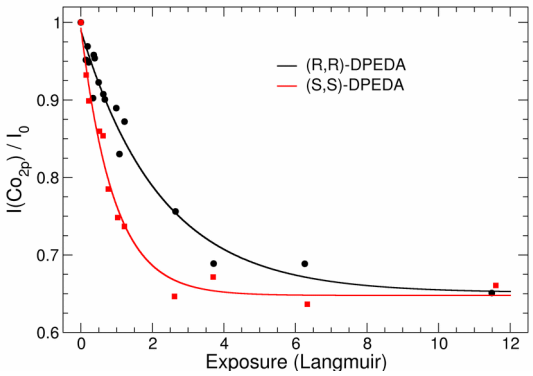

Figure 1: *Different adsorption rates of the two chiral forms of DPEDA as revealed by the attenuation of the XPS signal of the spin-polarized Co substrate.*

References:

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