Enantioselective Synthesis and Separation with Chiral-Encoded Metal Surfaces

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Enantioselective synthesis and separation of chiral compounds are of crucial importance for many potential applications ranging from sensing to catalysis. Recently, we have successfully elaborated chiral imprinted mesoporous platinum by electrochemical reduction of platinum salts in the simultaneous presence of a liquid crystal phase of nonionic surfactants and various chiral template molecules, such as enantiomers of 3,4-dihydroxyphenylalanine (DOPA), mandelic acid and phenylethanol. The chiral encoded mesoporous platinum perfectly retains the chiral information even after removal of the template and such a nanostructured platinum is able to break the symmetry during the electrosynthesis of chiral molecules such as mandelic acid and phenylethanol. By optimizing the electrochemical synthesis parameters, it is possible to achieve very high enantiomeric excess (>90 %) for the asymmetric synthesis of chiral compounds. In addition to imprinted platinum, we demonstrated also the synthesis of mesoporous chiral imprinted nickel as an alternative cheap and earth-abundant metal. Interestingly, it can also lead to very high enantiomeric excess (>80 %) during chiral electrosynthesis of phenylethanol. Apart from asymmetric synthesis, chiral separation can be achieved using also such imprinted mesoporous metals as a stationary phase in a microfluidic channel. By fine-tuning the electrostatic interactions between the encoded surfaces and the corresponding chiral molecules via applying an electric field, it is possible to achieve complete separation of chiral compounds. Therefore, these designer surfaces open new promising horizons in various fields of electrochemistry, ranging from electroseparation to electrosynthesis.

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