Chiral Nanomaterials for Application in Enantioselective Chemical Processing

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Materials can be prepared in such a way that they have chiral structures at the nanoscale. Metal surfaces with high densities of monoatomic kinked step edges can exist in two enantiomerically related forms. Nanoparticles can be rendered chiral by the adsorption of chiral ligands. The chirality of nanomaterials can be used as the basis for enantioselective chemical processes that are critical to the production of enantiomerically pure chiral compounds such as pharmaceuticals, fragrances, and various bioactive agents. High Miller index planes of metal surfaces are chiral in spite of the fact that the bulk structures of metals are not. As a consequence of their chirality, the chemistry of chiral molecules on these surfaces is enantiospecific and can be controlled by the chirality of the surface. Adsorption energies, adsorbate orientations and adsorbate reaction kinetics are enantiospecific and, in some processes the naturally chiral surfaces of metals can be lead to extremely high enantiospecificity. Similarly, the surfaces of metal nanoparticles can be made chiral, most often by the adsorption of chiral ligands. These render the surfaces of these nanoparticles chiral and such nanoparticles have been show to serve as enantiospecific adsorbents for enantiospecific separations of racemic mixtures of chiral molecules.