Advanced synthesis methods for the preparation of layered materials

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Clay minerals are described as natural sedimentary compounds resulting from the alteration of rocks. Due to their abundance and specific physico-chemical properties, they were among the first materials used by man. Nowadays, in parallel to their conventional uses as adsorbents, additives or excipients, clay minerals continue to be studied to develop new advanced multifunctional materials. Within this family of minerals, anionic clays also called Layered Double Hydroxides (LDH) present a two-dimensional structure and are distinguished from phyllosilicates by a stacking of cationic octahedral layers, essentially constituted by divalent (Mg^{2+}, Zn^{2+}, Ni^{2+}...) and trivalent metals (Al^{3+}, Fe^{3+}, Cr^{3+}...). Not very abundant in nature, LDH have the advantage of being synthesized in the laboratory by soft chemistry. In order to illustrate the interest of soft chemistry for the elaboration of these lamellar matrices, we will show how a judicious choice of the strategies and conditions of synthesis makes it possible to modulate the chemical composition of LDH but also, the size and the shape of the particles. These syntheses, combined with shaping processes give access to nanostructured LDH matrices. The examples provided will be extended to the elaboration of LDH hydrides associating inorganic sheets and organic molecules, as well as to LDH biohybrid materials in which proteins or bacteria are immobilized without denaturing their biological activities.