

CUSTOMIZED MATERIALS FOR DEPOLLUTION, RECYCLING AND ENCAPSULATION

An innovative method for creating Layered Double Hydroxides (LDHs) with customized properties that enable multiple applications such as pollutant extraction, metal recycling from electronic waste, and a novel application that is the encapsulation of active substances.

Context

Layered double hydroxides (LDHs) are inorganic materials composed of charged stacked layers with charge-balancing anions located in the interlayer regions. In natural LDHs, the most common anion is carbonate. In synthetic LDHs, a range of interlayer anions can be incorporated from small inorganic anions to complex biomolecules.

LDHs have a broad range of applications in catalysis, electrochemistry, biomedical and environmental sciences. In particular, LDHs can be used for anion exchange and anion extraction processes and as a controlled release drug or phytochemicals delivery systems. However, LDHs are only found commercially as Mg-Al carbonate hydrotalcite. It is therefore necessary to synthesize customized LDHs for any application. Current methods are not satisfactory in many regards *e.g.* complex protocol, high energetic cost, limited range LDHs. There is thus a need for a simple, efficient and cheap method to prepare customized LDHs and for a cost-effective method of anion extraction from a medium (*e.g.* to depollute or recycle a substance).

Invention description

The invention is a new method for exchanging interlayer anions of LDH with other anions whose affinity for the LDH is lower than the one of the initial interlayer anions. The first step consists in exchanging the starting interlayer anions of a LDH with polyoxometalate anions. The second step implies the exchange of polyoxometalate anions of the LDH with other anions whose affinity for the LDH is lower than that of the initial interlayer anions, in chemical conditions chosen to destabilize the polyoxometalate. This method is useful for the preparation of customized LDH and as mentioned in the prior art for extracting anions from a liquid medium (with a third step to regenerate the LDH).

Added value

This method can be implemented in a continuous way, and can use as starting point any LDH, including the commercially available Mg-Al carbonate hydrotalcite. The invention thus allows an easy access to LDHs with various types of interlayer anions *e.g.* drug, biomolecule, catalyst, anti-corrosive agent, depending on the application considered.

Potential market

- **Electronic waste firms**

Extraction in liquid medium of critical and strategic metals from electronic waste

- **Paint industries**

Encapsulation of anionic active substance in paints as corrosion inhibitor

- **Pharmaceutical industries**

Encapsulation of drugs *e.g.* ibuprofen

- **Phytosanitary industries**

Encapsulation of herbicides *e.g.* picloram

- **Environment/Sustainable development**

Depollution, recycling

Keywords

LDH; polyoxometalate anions; interlayer anion exchange; aqueous solution metal extraction; recycling, depollution, encapsulation

Technology domain

Chemical engineering; environmental technology; materials; metallurgy; drug vectorisation

Intellectual property

Patent

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Technology transfer contact

psl.valo@psl.eu