Graphene Oxide supported Layered Double Hydroxides for CO_2 capture applications

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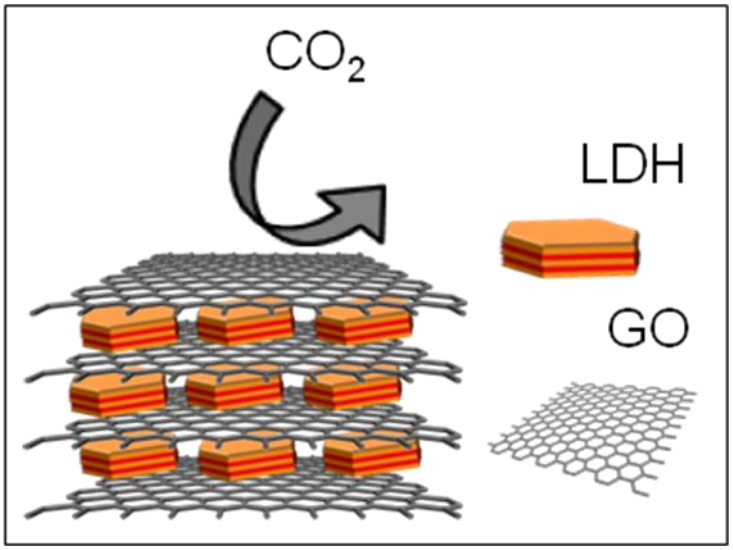
Layered double hydroxides (LDHs), also known as hydrotalcite-like compounds, belong to a large class of synthetic two-dimensional (2D) nanostructured anionic clays. Their structure is composed of positively charged brucite-like $Mg(OH)_2$ layers in which a fraction of divalent cations, octahedrally coordinated by hydroxyls, are partially substituted by trivalent cations. The excess of positive charge is balanced by intercalated anions. The potential of LDHs as CO_2 adsorbent materials open an attractive alternative to the current carbon capture and storage (CCS) technologies. LDHs require less energy to be regenerated and show better multi-cycle stability than other potential CO_2 solid adsorbents (e.g. calcium oxides). Despite these positive adsorption properties, LDHs commercial use is limited because they possess a relatively low CO_2 adsorption capacity. Recently, we have observed that the CO_2 adsorption performance of LDHs is considerably enhanced by supporting them onto oxidised multi-walled carbon nanotubes (MWNT). [1] Following a similar strategy, here we have used graphene as an ideal atomic-thick 2D material to, in principle, maximize the contact area with the 2D LDHs and in turn enhance the CO_2 uptake capacity of the assembly.

Specifically, LDH nanoparticles were precipitated directly onto graphene oxide (GO) and the dependence of the structural and physical properties of the Mg-Al LDH have been studied, using electron microscopy, X-ray diffraction, thermogravimetric analysis (TGA), and BET surface area measurements. After a thermal decomposition, layered double oxides (LDO) are obtained with the basic sites required for the CO_2 adsorption. In order to study the effect of the GO content in a LDO/GO hybrid, a range of samples with different proportions of LDO were prepared and fully characterised. It was found that the CO_2 adsorption capacity and multi-cycle stability of the LDO were both increased when supported onto GO due to an enhanced particle dispersion and gas accessibility.

References

[1] Garcia-Gallastegui A., Iruretagoyena D., Mokhtar M., Asiri A., Basahel S. N., Al-Thabaiti S. A., Alyoubi A. O., Chadwick D., Shaffer M. S. P. Submitted (2012).



Scheme 1. *Schematic representation of the synthesised LDH/GO hybrids.*