Graphene Oxide supported Layered Double Hydroxides for CO_2 capture applications

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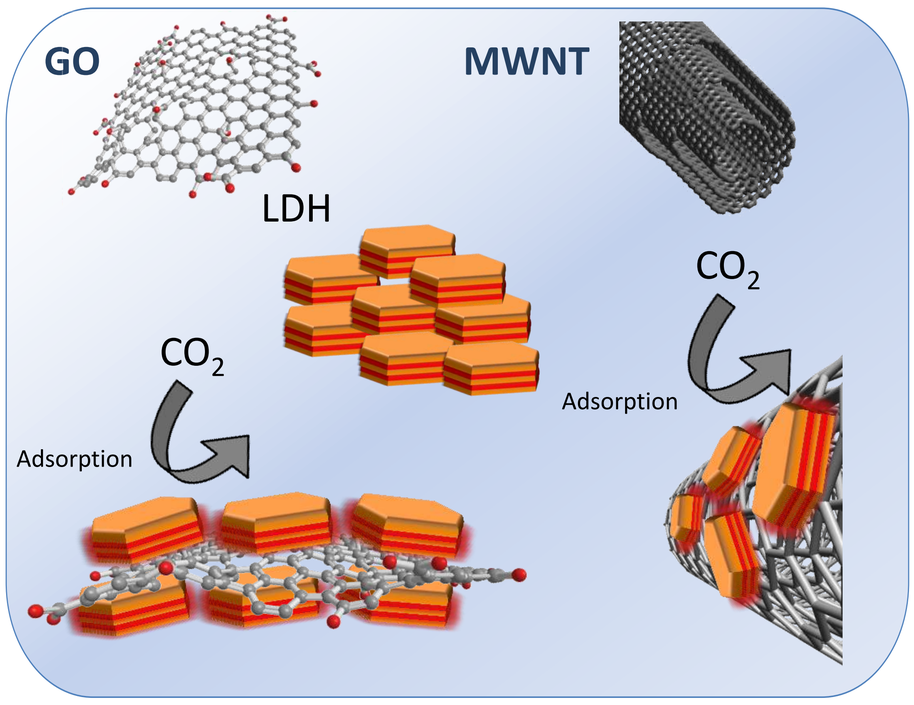
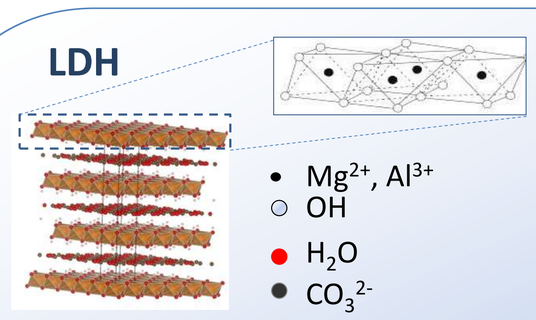
Introduction

Layered double hydroxides (LDHs) are promising materials for CO_2 adsorption, although improvements in performance are required for practical applications. 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 support the 2D LDHs. It has been found that the CO_2 adsorption capacity and multi-cycle stability of the LDHs were both increased when supported onto graphene oxide (GO) due to an enhanced particle dispersion and gas accessibility.

Aim of the research



Experimental details



Procedure

1st Precipitation

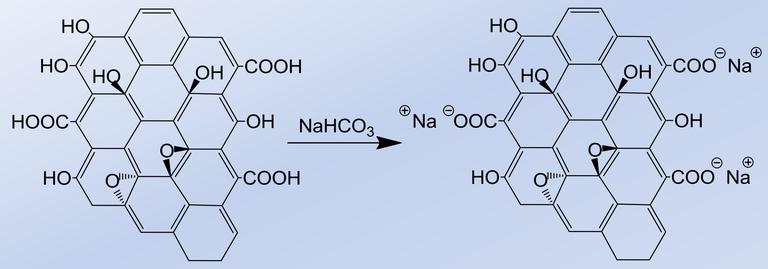
$Al(NO_3)_3.9H_2O$
$Mg(NO_3)_2.6H_2O$

$NaOH$ + GO
$NaCO_3$

2nd Calcination

GO

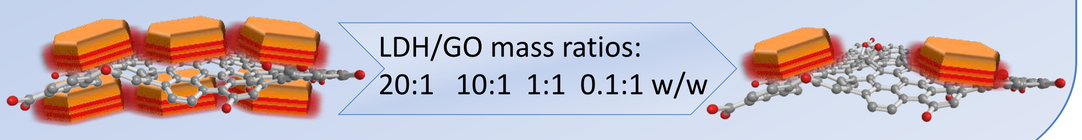
Carboxylic acid groups determined by titration: 1.23 mmol/g



+ $NaHCO_3$ (determined by titration)

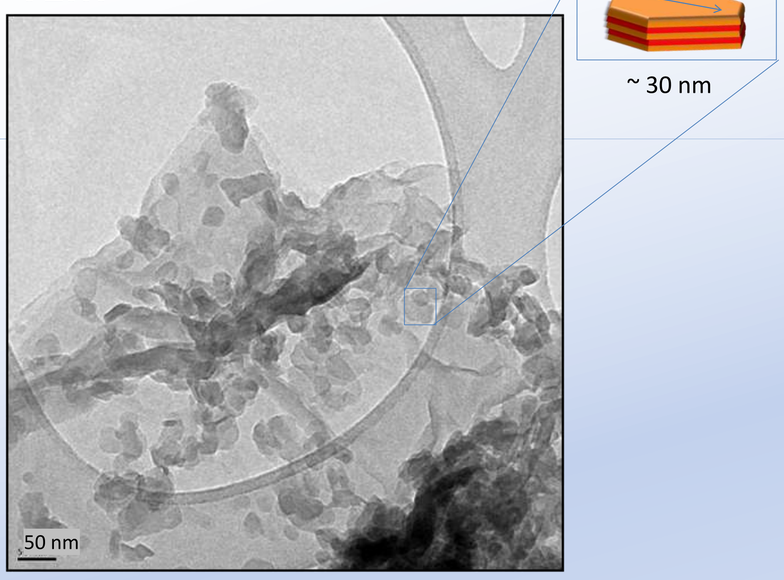
Products

4 different LDH/GO mass ratios



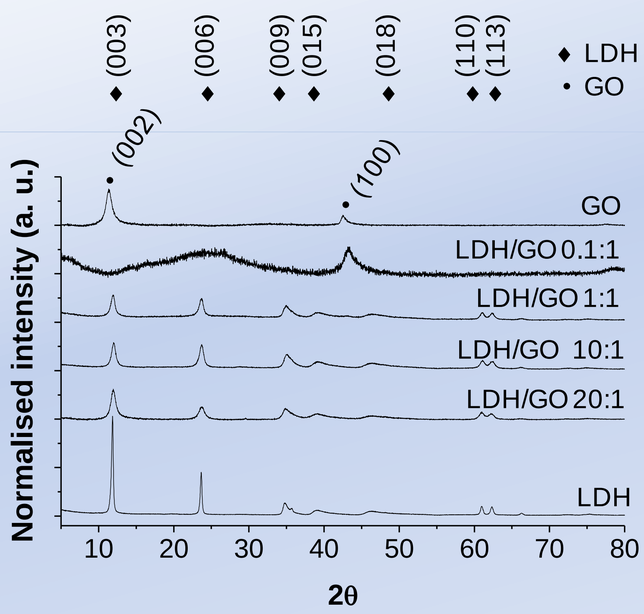
Characterisation

TEM



XRD

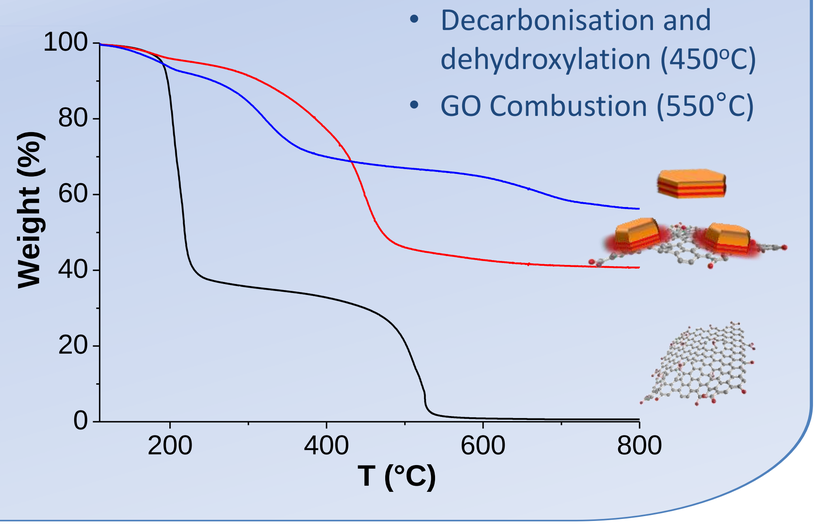
LDH structure corroborated



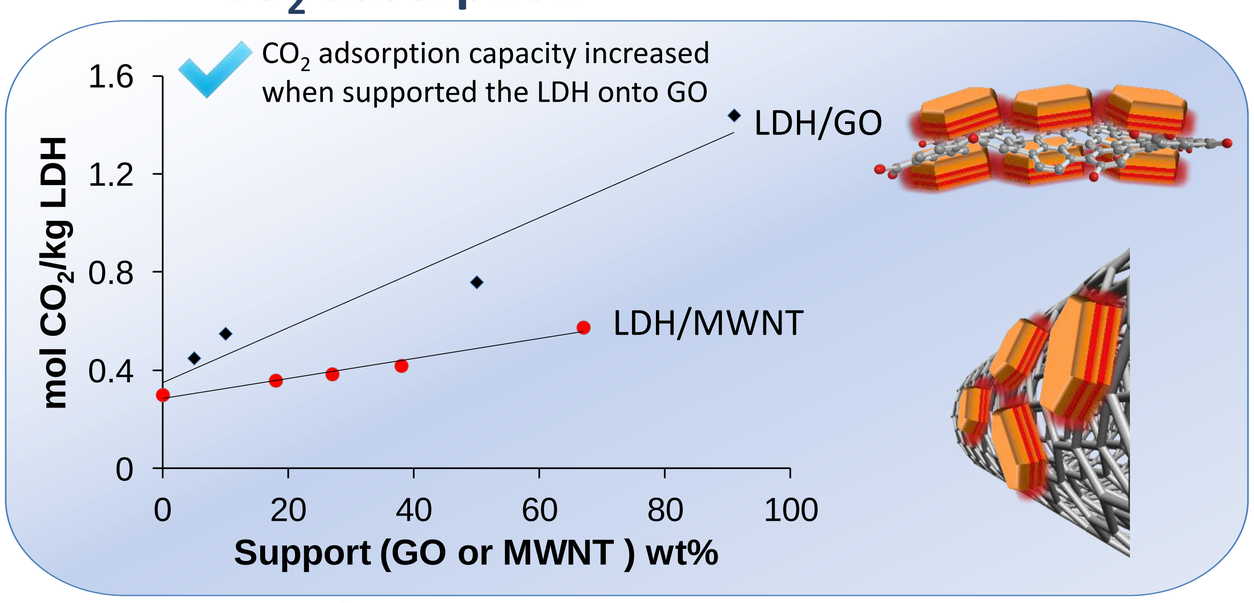
TGA

Actual loading estimation

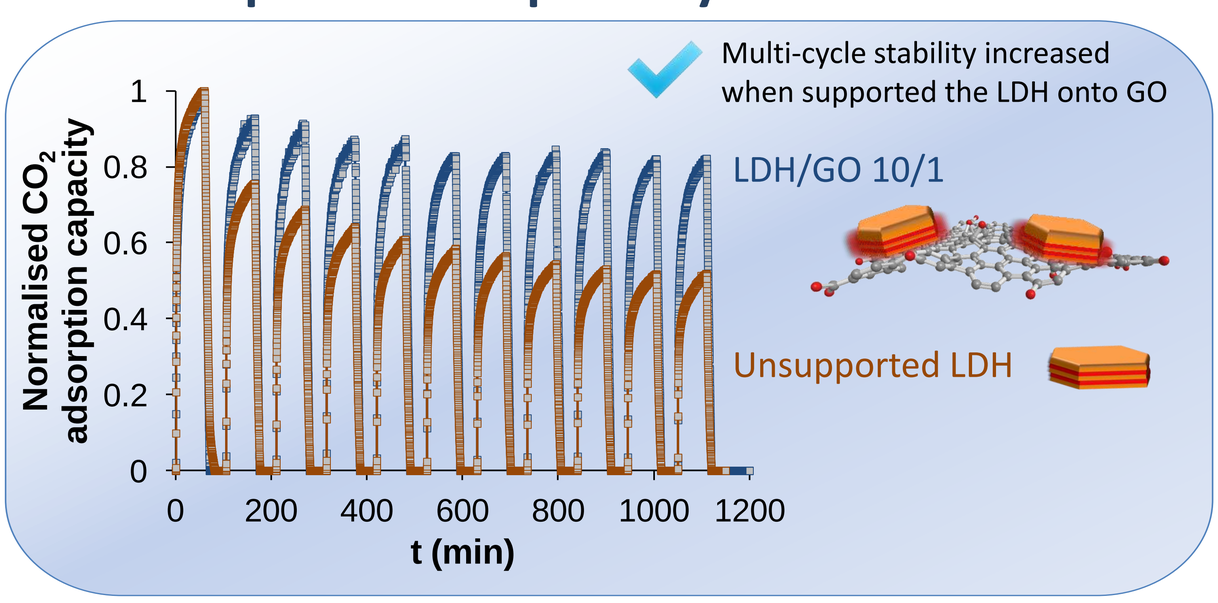
- Dehydration (210°C)
- Decarbonisation and dehydroxylation (450°C)
- GO Combustion (550°C)



CO_2 adsorption



Adsorption-desorption cycles



Conclusions

- The CO_2 adsorption capacity of the activated LDH materials was shown to be higher when supported on GO in comparison with the unsupported LDH.
- The stability of the LDH materials was increased significantly when supported on GO making them more attractive for commercial applications. The flat GO geometry seems well suited to the geometry of the LDH and this seems to play an important role in the enhancement of the CO_2 adsorption capacity.

[1] A. Garcia-Gallastegui, D. Iruretagoyena, M. Mokhtar, A. M. Asiri, S. N. Basahel, S. A. Al-Thabaiti, A. O. Alyoubi, D. Chadwick, M. S. P. Shaffer *J. Mater. Chem.* **2012**, submitted.

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