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ZnCr layered double hydroxide as a photocatalytic additive for NO_x gases remediation in building materials

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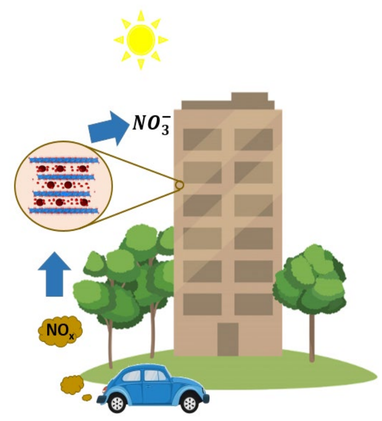
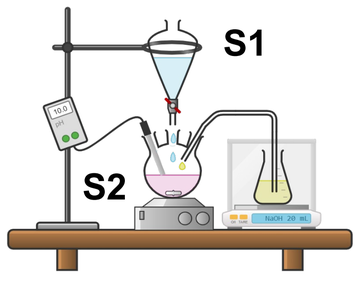
INTRODUCTION

Removal of atmospheric pollutant is an environmental issue with a great scientific and social interest. One of the best known and the most impactful pollutants in urban areas are nitrogen oxides (NO_x), which derived mainly from the burning of fossil fuels [1]. Building materials with photocatalytic additives are a promising solution to reduce NO_x air pollution (DeNOx action) in big cities. Several studies of building materials with titanium dioxide (TiO_2) have been carried out [2] Nevertheless, this photocatalyst exhibits some disadvantages like it is active only under UV light irradiation and high cost [3]. In this sense, it is interesting to study new photocatalytic compounds as $DeNO_x$ additives for building materials. Layered double hydroxides (LDH), are a group of compounds whose general formula is $[M^{2+}_{1-x}M^{3+}_{x}(OH)_2](A^n)_{x/n}\cdot mH_2O$. Because of the variety of metals that can incorporate in its structure, LDHs can be formulated as UV and/or Visible light photocatalysts. This work study the preparation and characterization of $Zn_2Cr\text{-}CO_3$ LDH as new $DeNO_x$ photocatalytic additive.

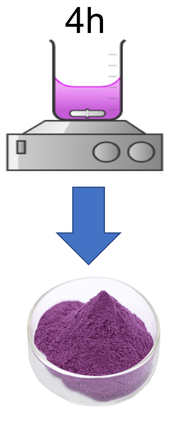


SYNTHESIS OF LDH



AMOST method

Ethanol 4h



S1	100 mL	$ZnCl_2$ 0.66 M $CrCl_3$ 0.33 M
S2	100 mL	Na_2CO_3 0.17 M

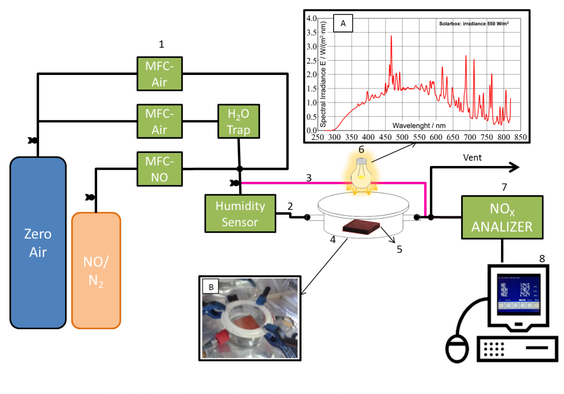
MORTARS PREPARATION

According to UNE-EN 196-1

Thin layer mortar + **Photocatalyst** =

ZnCr-LDH or TiO_2-P25
(0 , 0.5 , 1 , 1.5 , 2) %

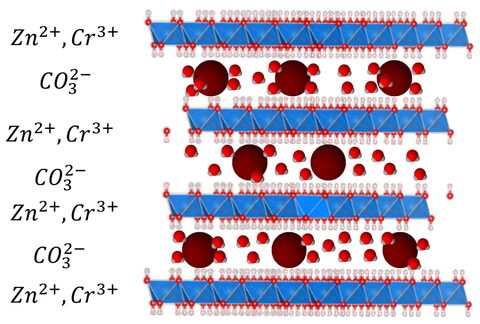
PHOTOCATALYTIC TEST

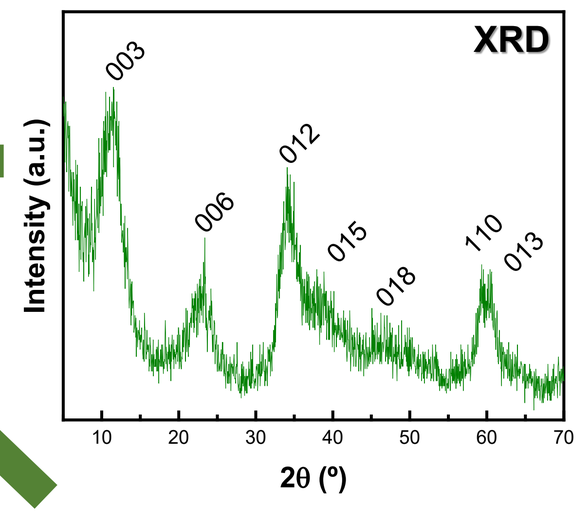


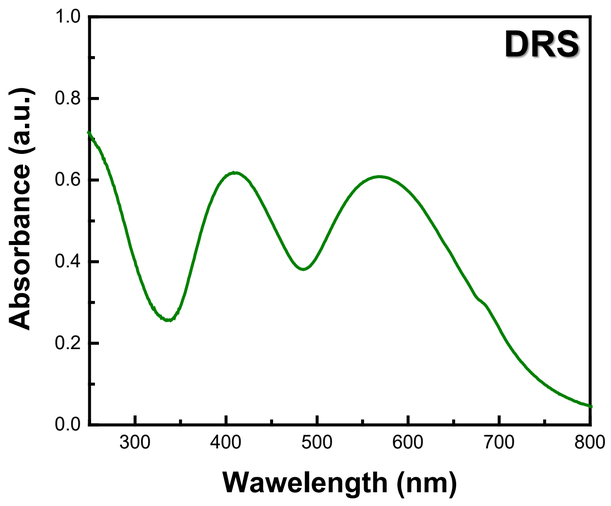
[NO] = 150 ppb
UV-Visible Irradiation = 6h

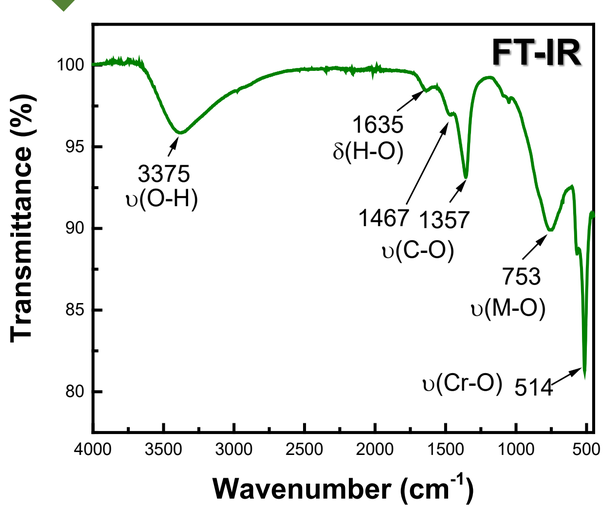
RESULTS

LDH CHARACTERIZATION



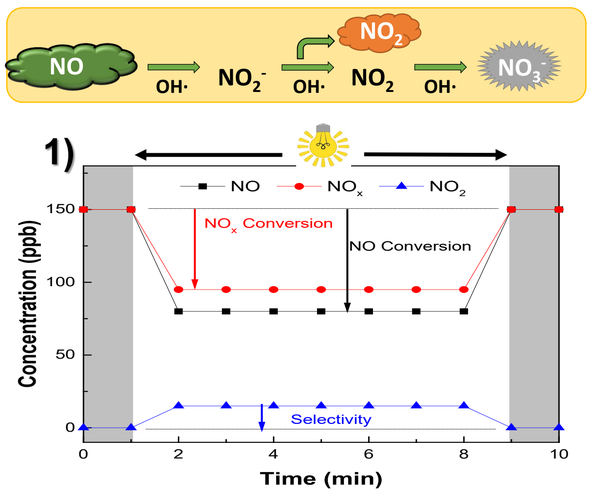


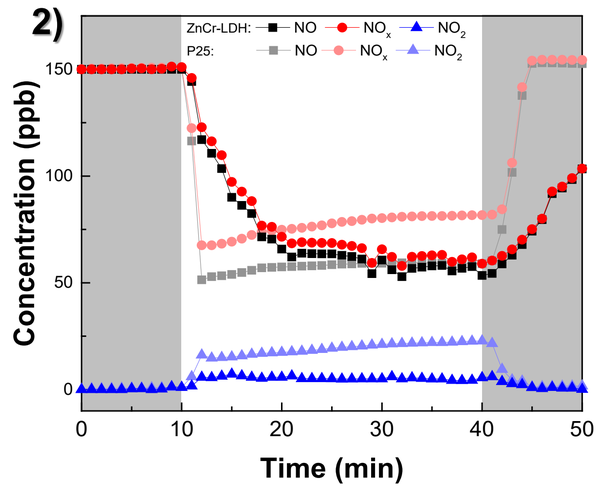




XRD pattern characteristic of LDH pure phase with low crystallinity. Characteristic **FT-IR** spectra of LDH containing carbonate in the interlayer. **DRS**: ZnCr-LDH can absorb light in a wide range of wavelengths from the UV to the Visible.

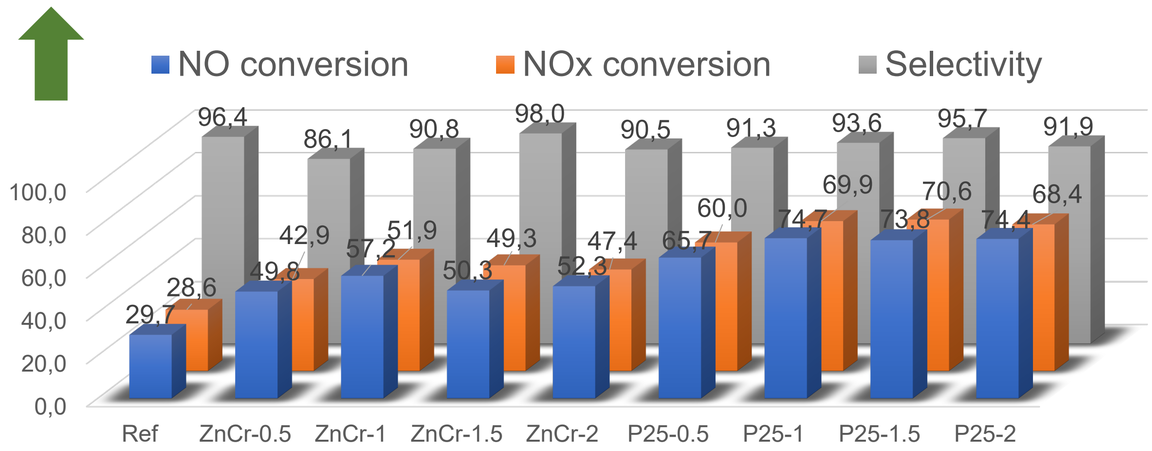
MORTARS PHOTOCATALYTIC TESTS





1) Example of photocatalytic test. 2) Photocatalytic test comparison of ZnCr-LDH (bold) and P25 (shadow) in powder.

Photocatalytic results show that mortars containing ZnCr-LDH present close values to those which contain P25. Regarding the different compositions studied, ZnCr-LDH mortars containing 1% of photocatalytic additive show the best results (NO conversion: 57.2% and Selectivity: 90.8%).



CONCLUSION

1) ZnCr-LDH was easily synthetised using the AMOST method, showing low crystallinity
2) The good DeNOx response exhibited by the ZnCr-LDH mortar encourage the study of LDH compounds as advanced photocatalyst for building materials.

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