Modulation of Layered Double Hydroxides for photocatalytic air purification

UNIVERSIDAD DE CÓRDOBA

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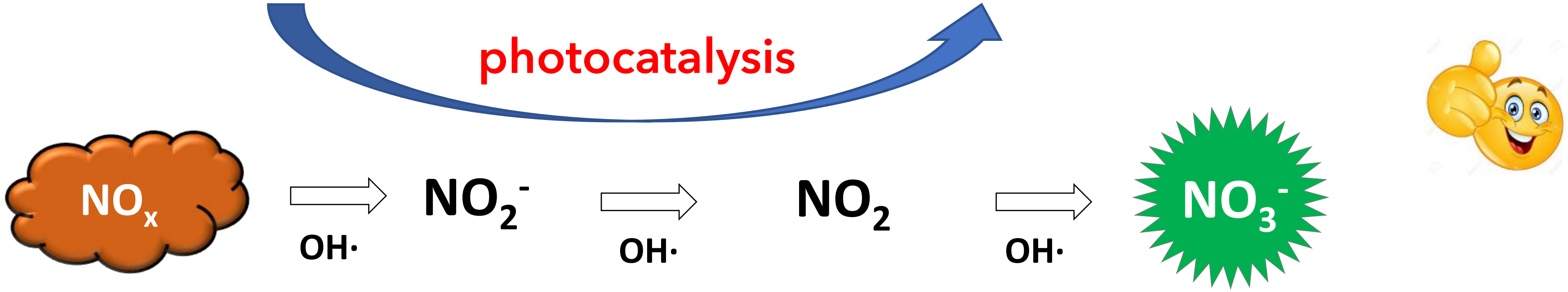
WORKSHOP
PHOTOCATALYSIS FOR ENERGY AND CLEAN ENVIRONMENT

UNIVERSIDAD DE MÁLAGA

MÁLAGA, OCTOBER 18TH 2022



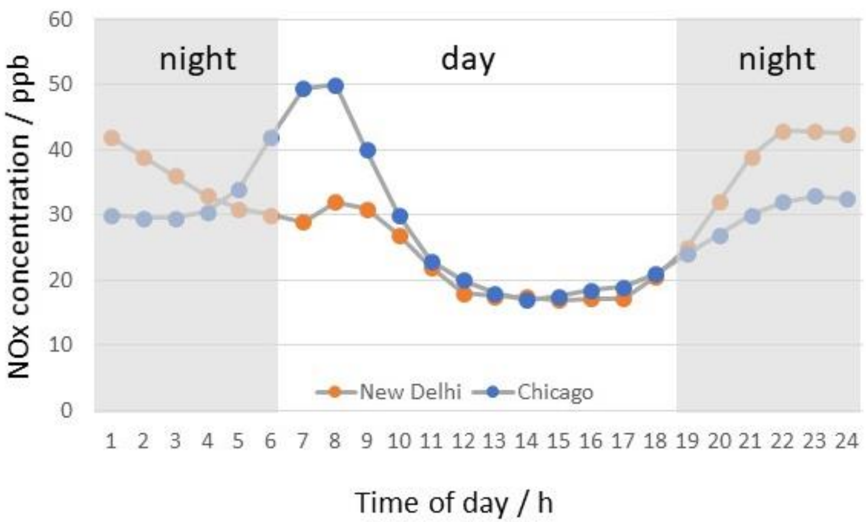
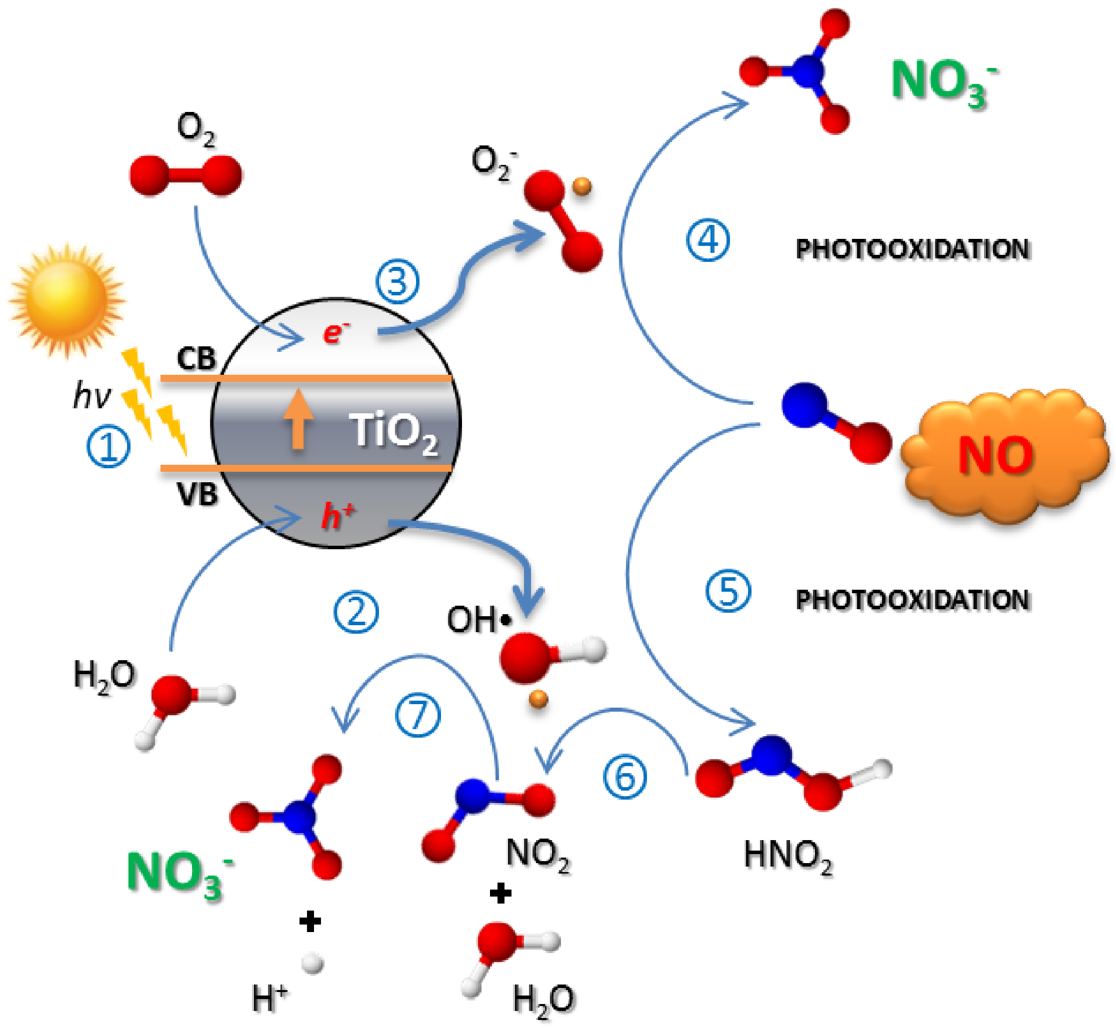


Figure 1: Diurnal profiles of NOx concentrations at urban centers

Photochemical De-NO_x mechanism



Review

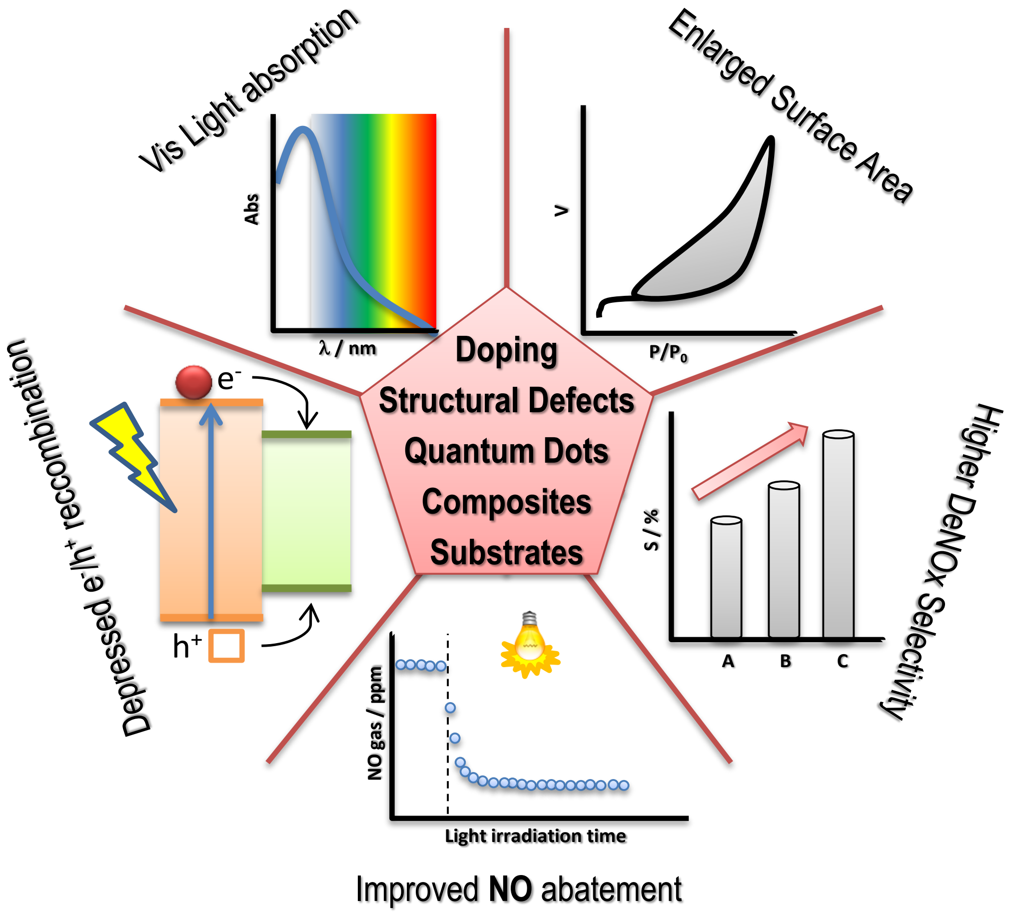
Journal of Nanoscience and Nanotechnology
Vol. 15, 6373–6385, 2015
www.aspbs.com/jnn

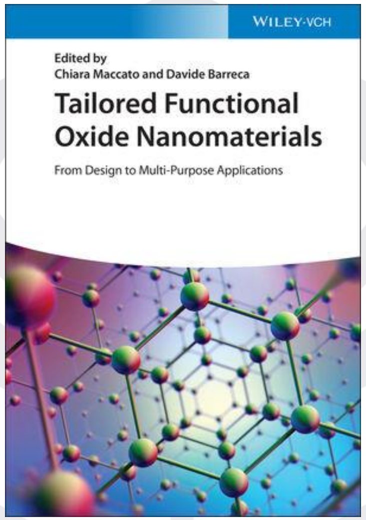
Nanomaterials to Combat NO_X Pollution

J. Balbuena, M. Cruz-Yusta, and L. Sánchez*

Departamento de Química Inorgánica, Facultad de Ciencias–Universidad de Córdoba, Campus de Rabanales, Edificio Marie Curie, 14071–Córdoba, Spain

New materials to combat NO_x gases





L. Sánchez et al. ***Metal Oxide Nanomaterials for Nitrogen Oxides Removal in Urban Environments***; in "Tailored Functional Oxide Nanomaterials: From Design to Multi-Purpose Applications" (Wiley - ISBN: 978-3-527-82693-3)

Layered Double Hydroxides (LDH) as De-NO_X photocatalysts

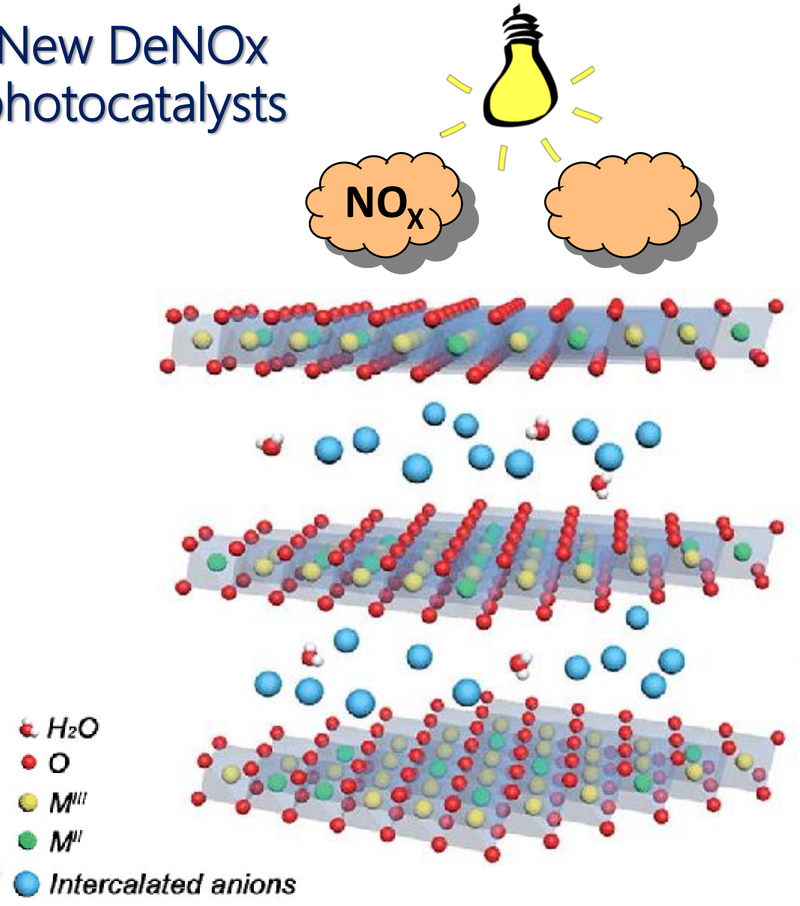
HDLfotoNOx

MAT2017-88284-P

2D/2DeNOx

PID2020-117516GB-I00

New DeNOx photocatalysts

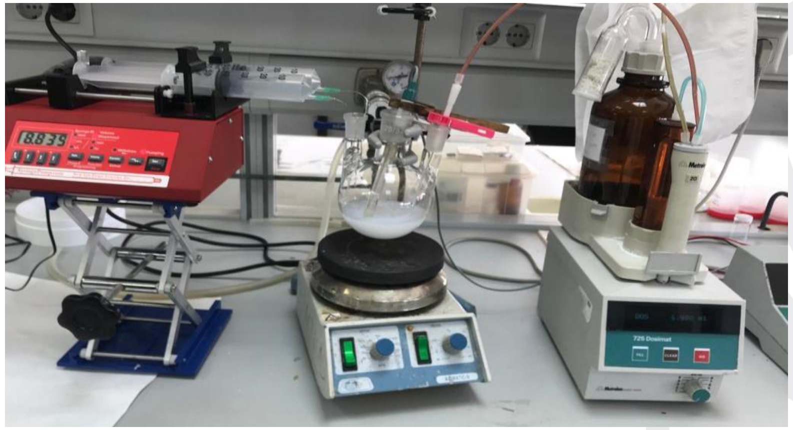


LDHs (Hidrotalcites)

- Based $Mg(OH)_2$ structure
- A versatile chemical fórmula :

$$[M_{1-x}^{II}M_x^{III}(OH)_2]^{x+} X_{x/n}^{n-} \cdot mH_2O$$

- An important group of photocatalysts
- Simple, low-cost and scalable synthesis.



Engineering Layered Double Hydroxide–Based Photocatalysts Toward Artificial Photosynthesis: State-of-the-Art Progress and Prospects

Sol. RRL **2021**, *5*, 2000535
DOI: 10.1002/solr.202000535

*Sue-Faye Ng, Michelle Yu Ling Lau, and Wee-Jun Ong**

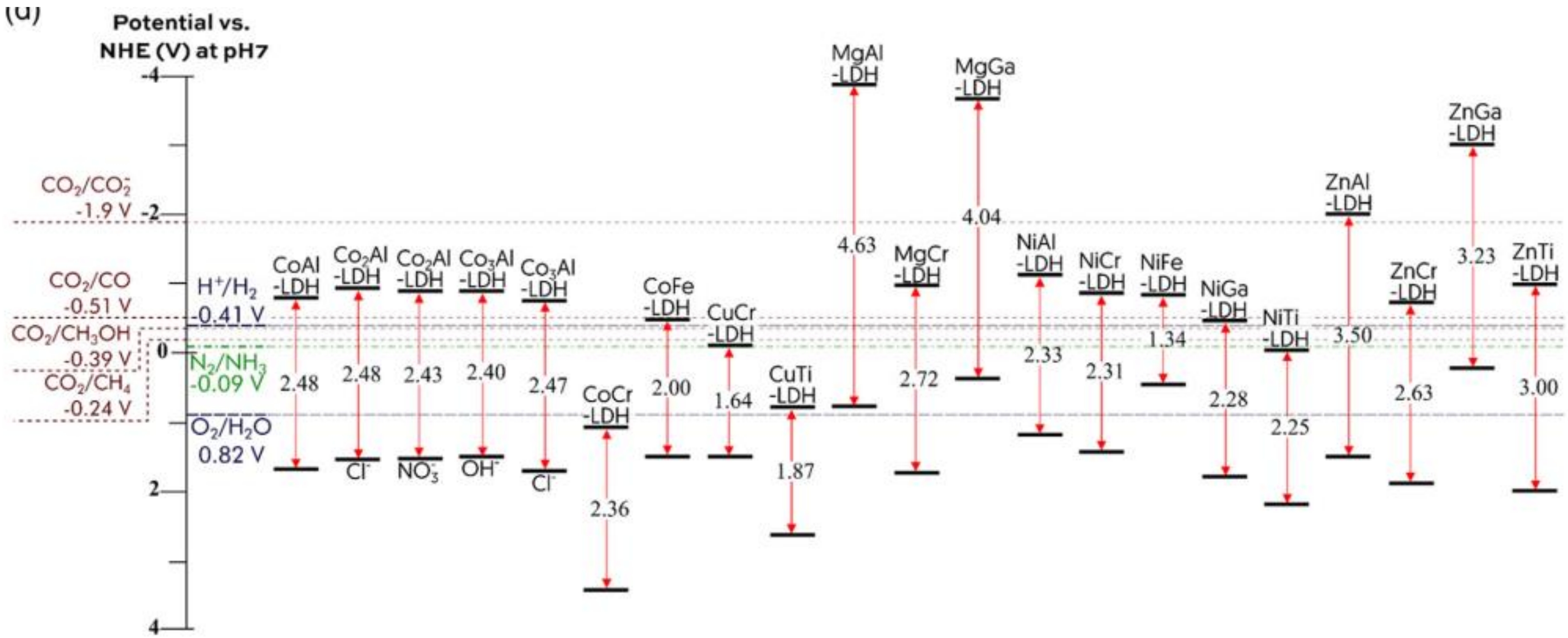
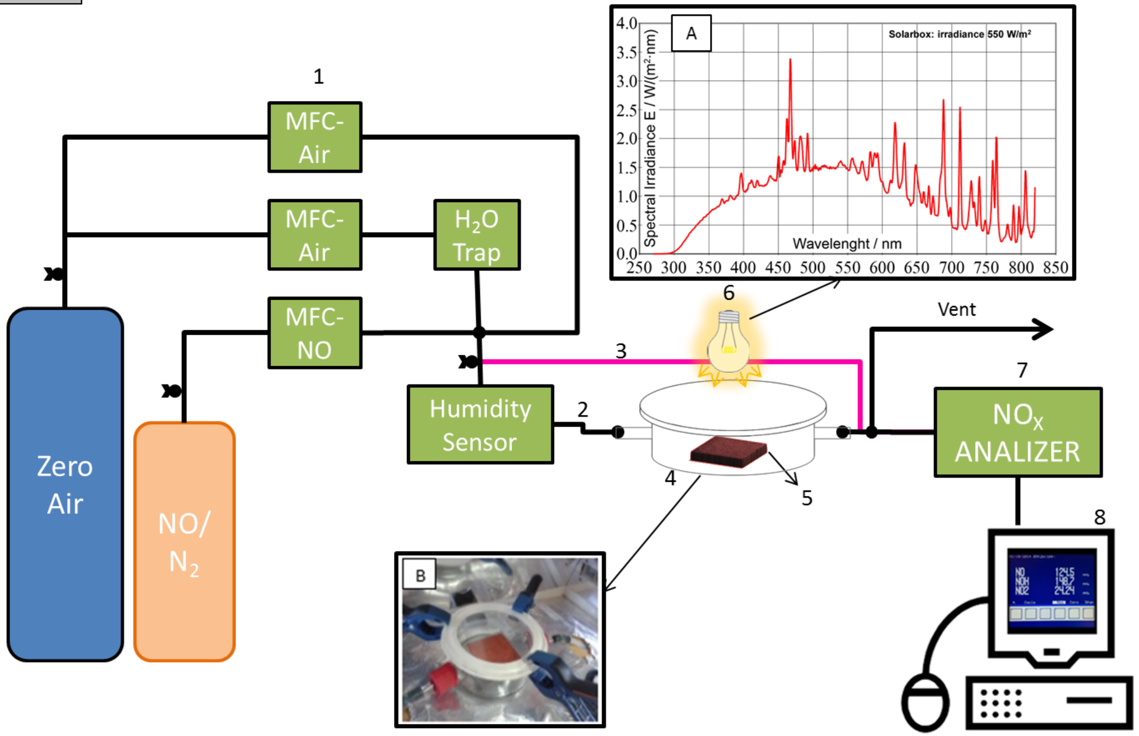
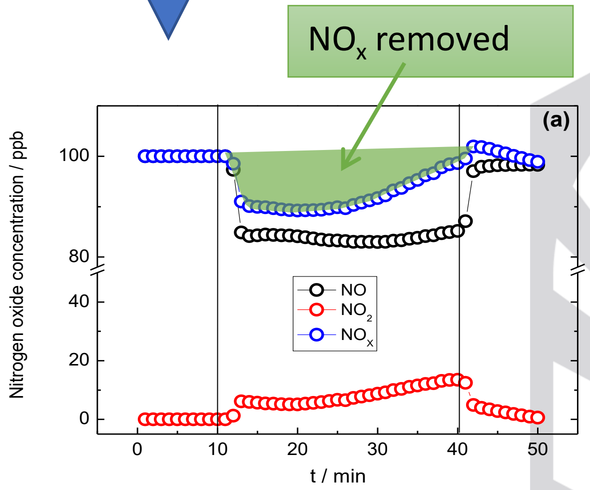


Figure 1. a) Divalent and trivalent metal cations in the periodic table which have been studied as the constituents of LDH. b) Number of yearly publications and c) citations from the year 2000–2020 with the topic keywords of "LDH & photocatal*" in the ISI Web of Knowledge database, dated 24th August 2020. d) Band positions of different LDH photocatalysts with respect to selected redox potentials of H_2O splitting, CO_2 reduction, and N_2 fixation.

De-NO_X test





Standar:

Evonik TiO_2-P25

(75 % anatase + 25 % rutile)

Chemical Engineering Journal 346 (2018) 151–158

Contents lists available at ScienceDirect

Chemical Engineering Journal

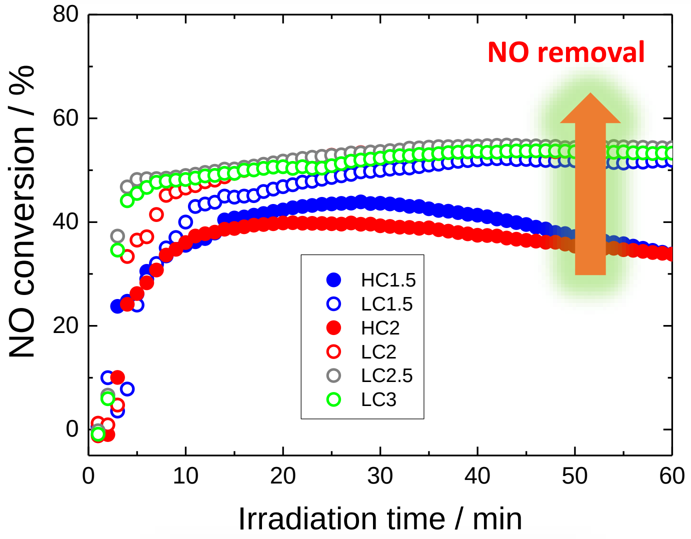
journal homepage: www.elsevier.com/locate/cej

Zn-Al layered double hydroxides as efficient photocatalysts for NOx abatement

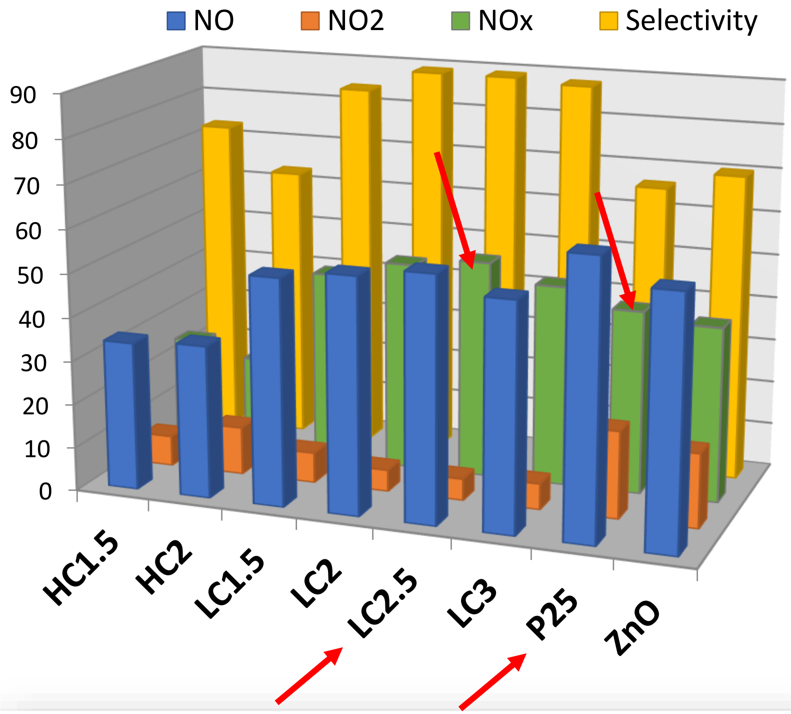
Fredy Rodriguez-Rivas[1], Adrián Pastor, Cristobalina Barriga, Manuel Cruz-Yusta, Luis Sánchez*, Ivana Pavlovic*

Systems: Zn_xAl-CO_3 (x : 1.5 – 3.0)

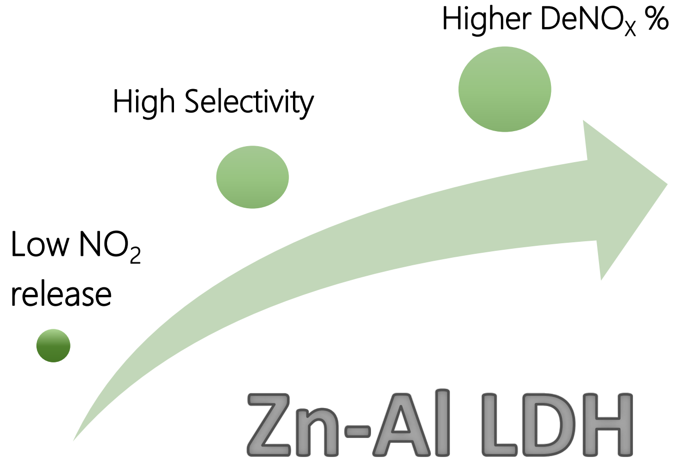
Key factors:
Specific surface area
Zn/Al ratio



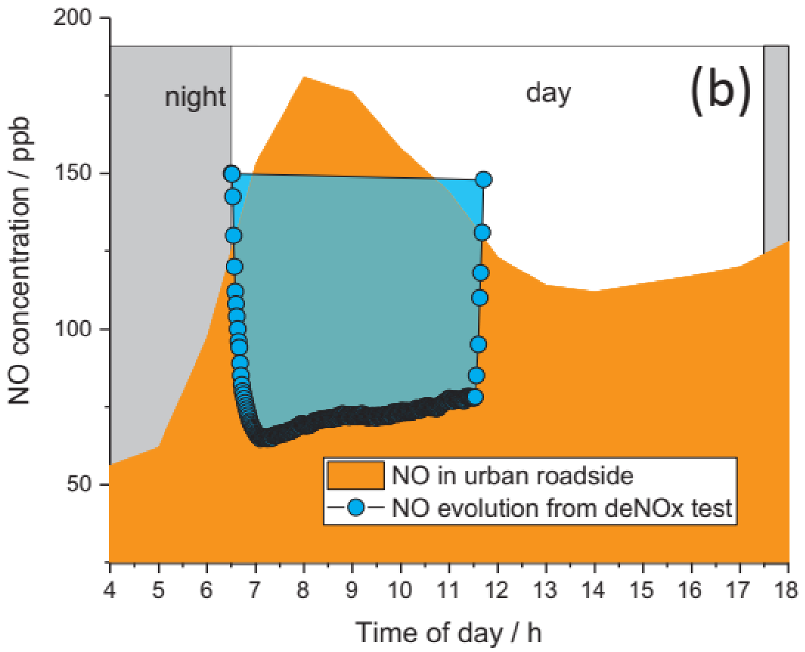
NO conversion efficiencies

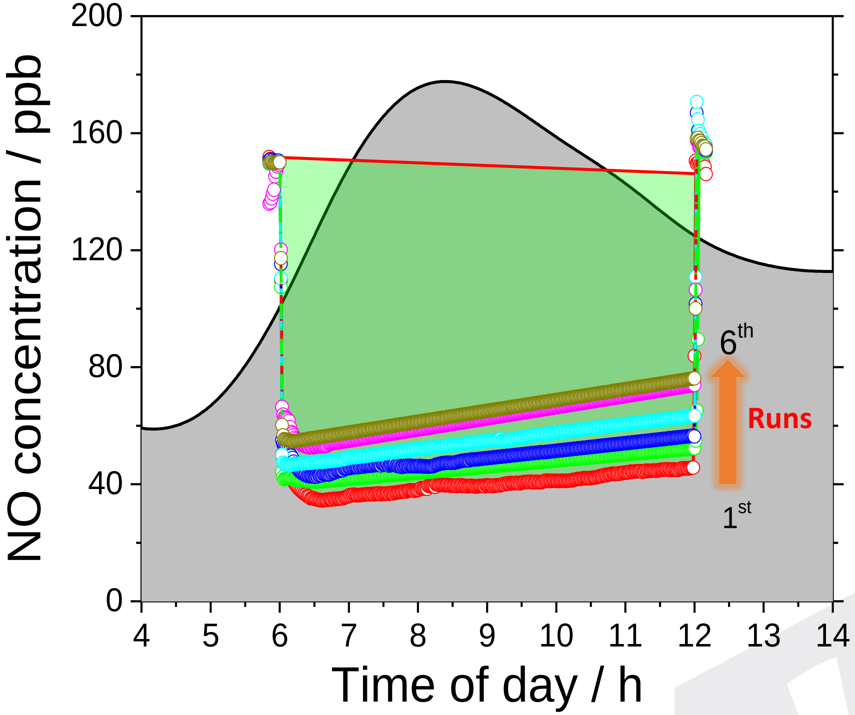


NO and NO_X conversion, NO_2 released and selectivity values



Photocatalytic De-NOx test ZnAl systems





Good reusability

!! Potential application to remove NOx gases from road traffic!!

Chemical Engineering Journal 387 (2020) 124110

Contents lists available at ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

Effects of Fe^{3+} substitution on Zn-Al layered double hydroxides for enhanced NO photochemical abatement

Adrián Pastor[a], Fredy Rodriguez-Rivas[a,b], Gustavo de Miguel[c], Manuel Cruz-Yusta[a], Francisco Martin[d], Ivana Pavlovic[a,*], Luis Sánchez[a,*]

Chemosphere 275 (2021) 130030

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Insight into the role of copper in the promoted photocatalytic removal of NO using $Zn_{2-x}Cu_xCr\text{-}CO_3$ layered double hydroxide

J. Fragoso [a], M.A. Oliva [a], L. Camacho [b], M. Cruz-Yusta [a], G. de Miguel [b], F. Martin [c], A. Pastor [a], I. Pavlovic [a,*], L. Sánchez [a,**]

Science of the Total Environment 706 (2020) 136009

Contents lists available at ScienceDirect

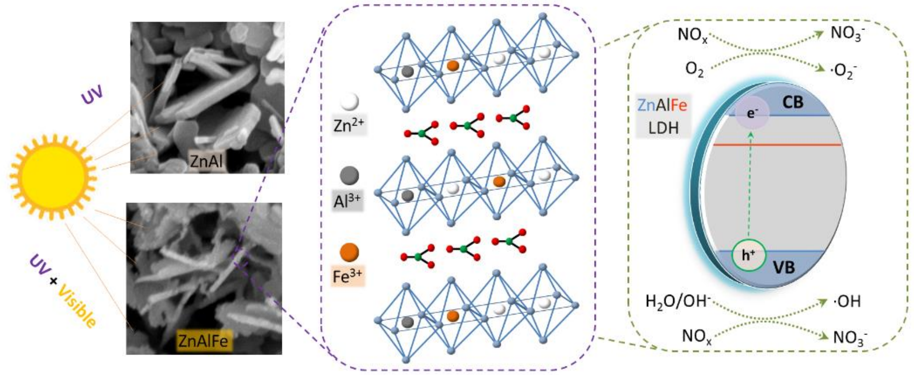
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

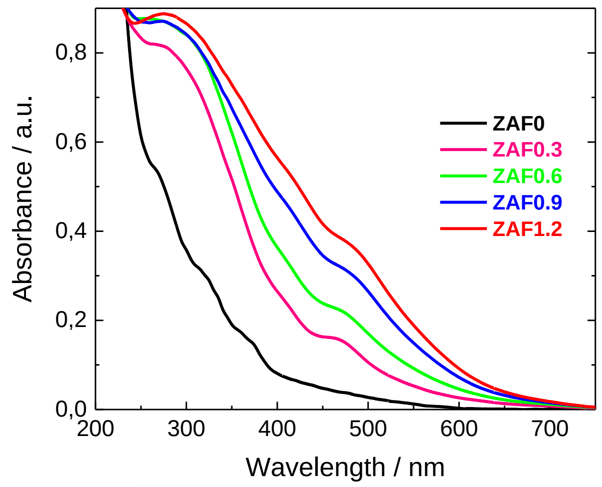
Cr^{3+} substituted Zn-Al layered double hydroxides as UV–Vis light photocatalysts for NO gas removal from the urban environment

Fredy Rodriguez-Rivas [a,b], Adrián Pastor [a], Gustavo de Miguel [c], Manuel Cruz-Yusta [a], Ivana Pavlovic [a], Luis Sánchez [a,*]

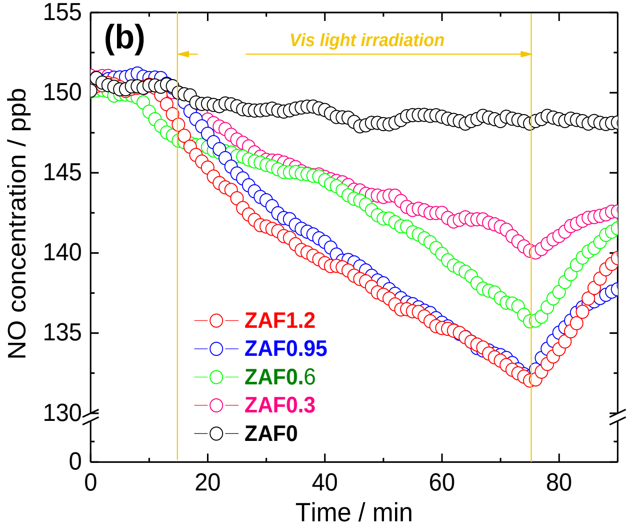
Systems: $Zn_3Al_{1-x}Fe_x$-CO_3 (x : 1.5 – 3.0)



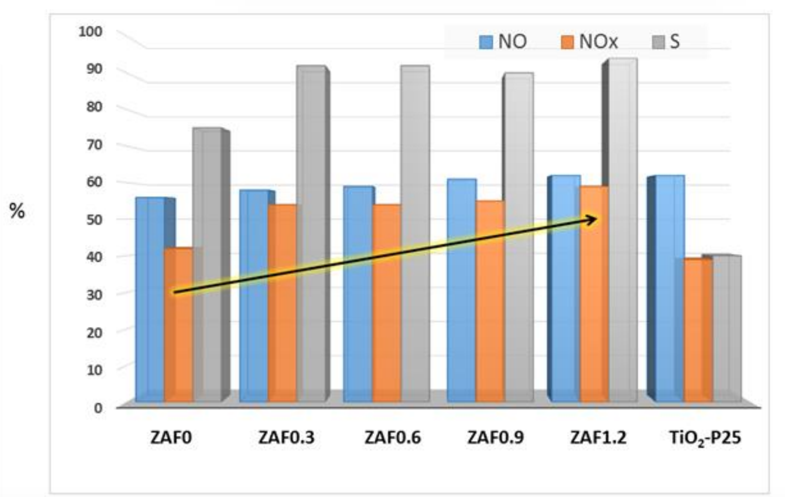
Visible light De-NOx photocatalysis



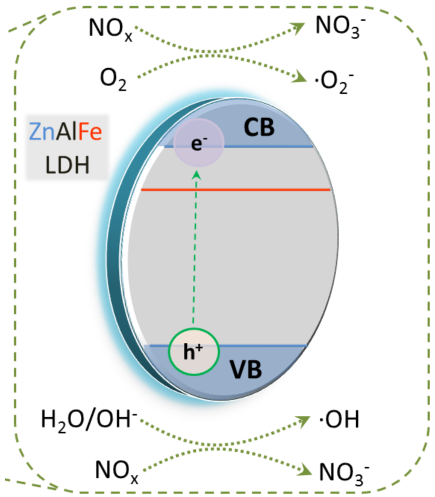
The UV–Vis absorption spectra

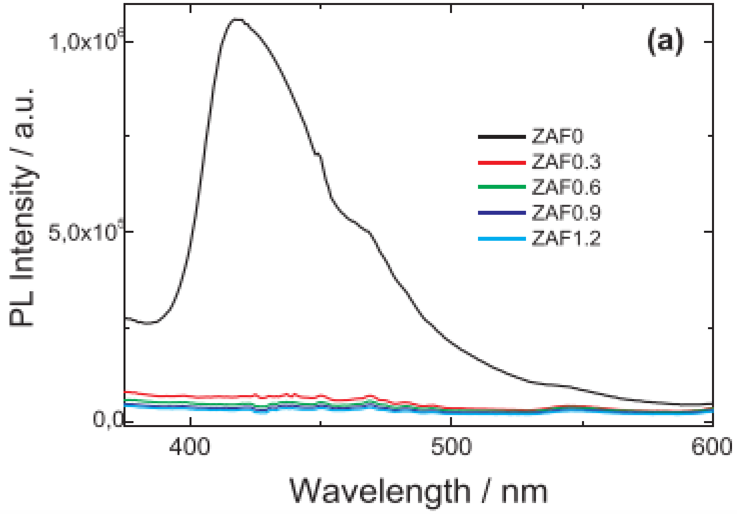


Nitrogen oxides concentration profiles

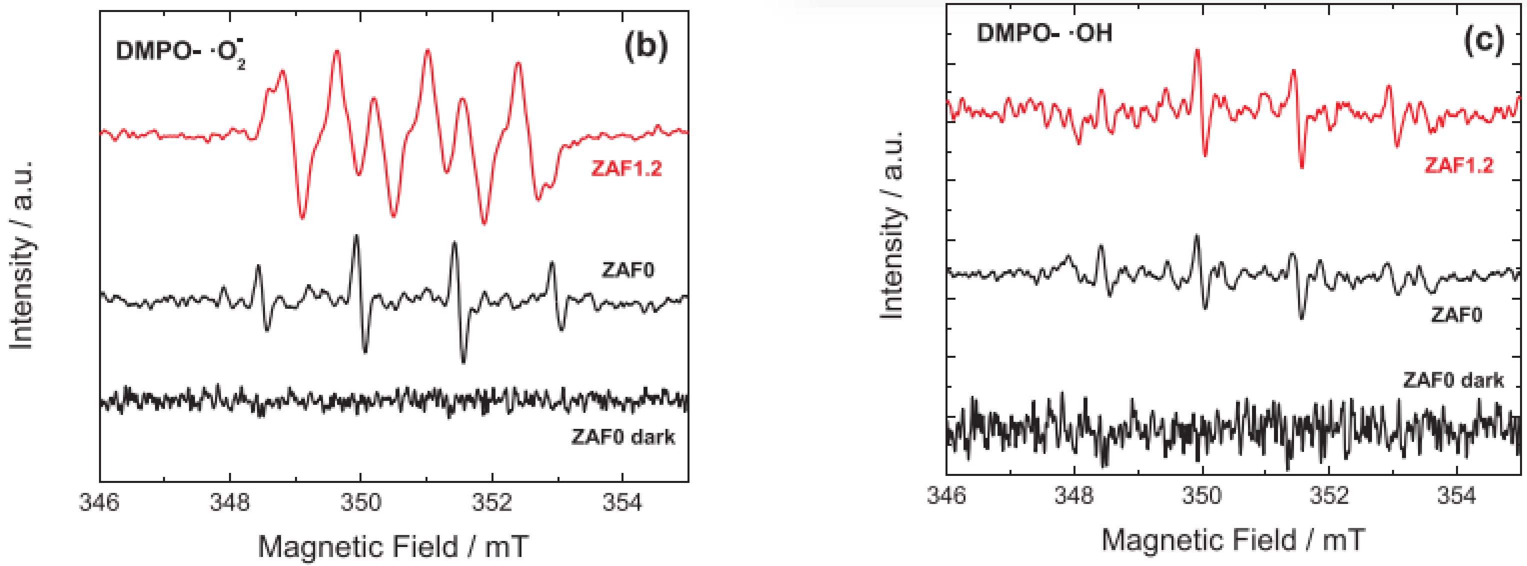


NO conversion, NO_X conversion and Selectivity values (%)





Photoluminescence (PL) spectra (excitation wavelength = 300 nm)



DMPO spin-trapping EPR spectra

Chemosphere 286 (2022) 131812

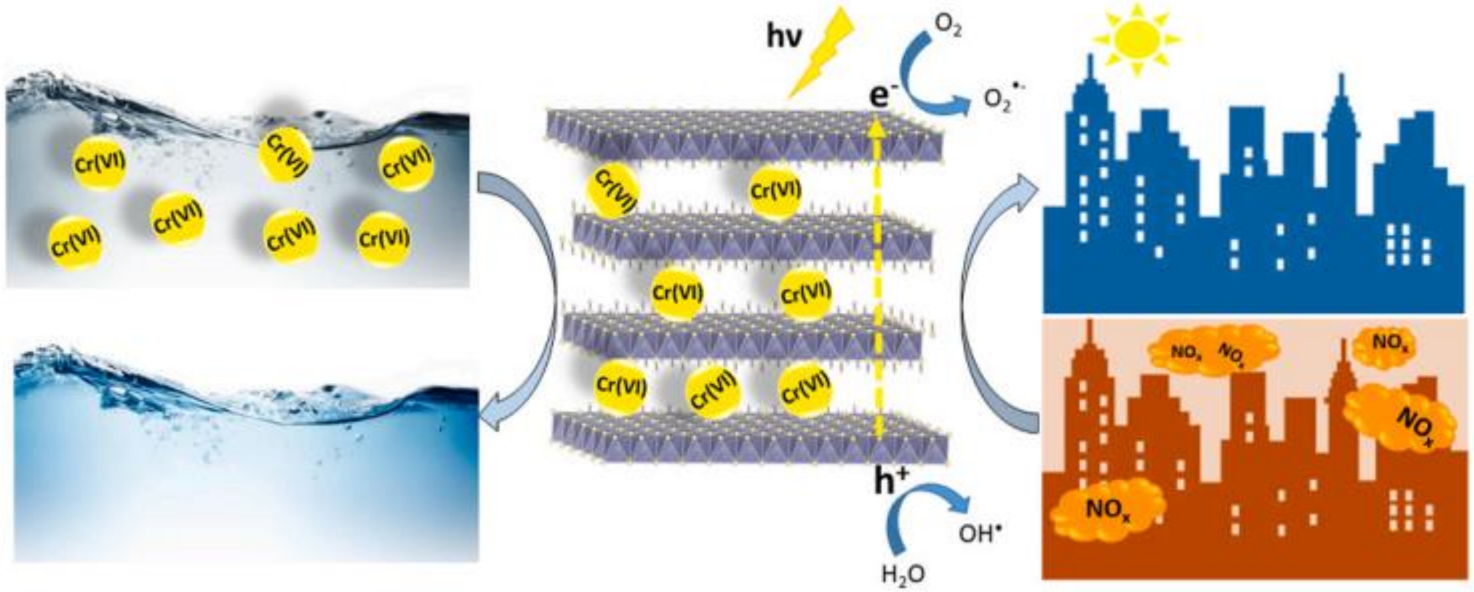
Contents lists available at ScienceDirect

Chemosphere

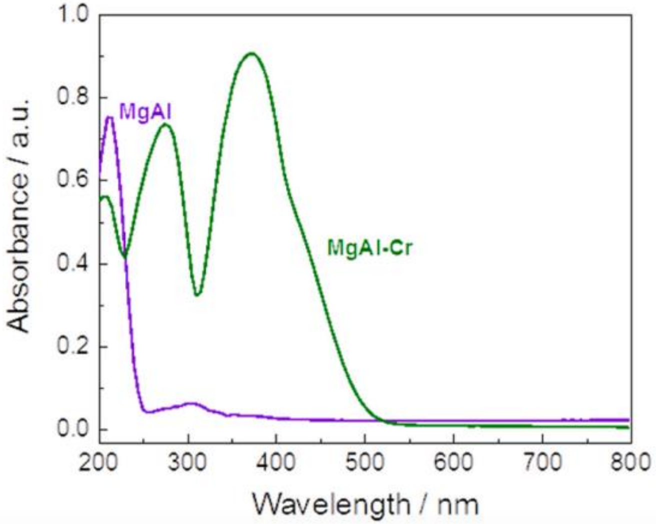
journal homepage: www.elsevier.com/locate/chemosphere

Use of LDH- chromate adsorption co-product as an air purification photocatalyst

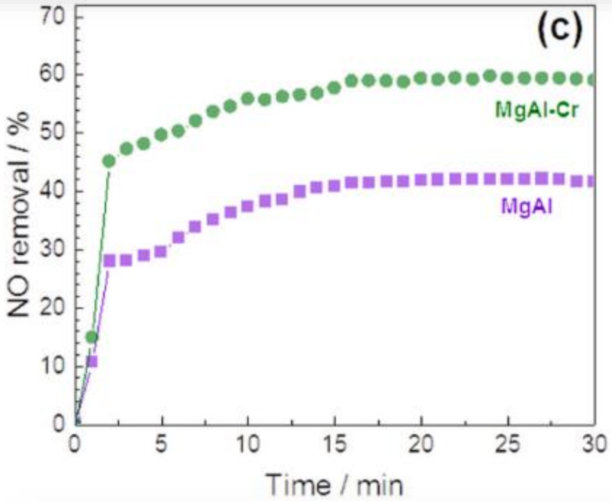
A. Nehdi [a], N. Frini-Srasra [a,b], G. de Miguel [c], I. Pavlovic [d,*], L. Sánchez [d], J.Fragoso [d,**]



System: $Mg_3Al\text{-}CrO_4$

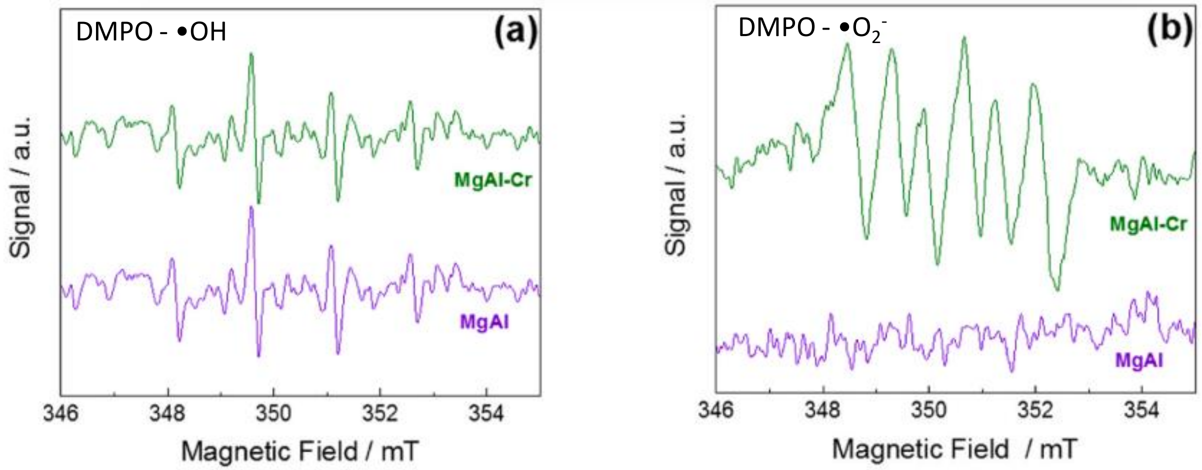


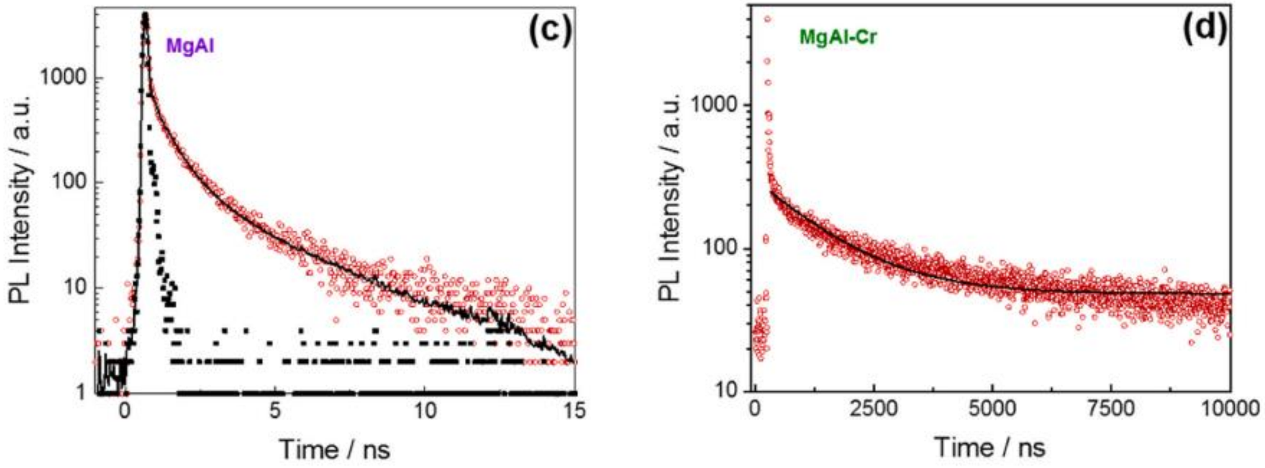
UV–Vis absorption spectra of the MgAl and MgAl–Cr samples.



NO removal efficiency for both LDH samples.

DMPO spin-trapping EPR spectra of the MgAl and MgAl–Cr samples





Decay times of the (c) MgAl and (d) MgAl–Cr samples.

Chemical Engineering Journal 429 (2022) 132361

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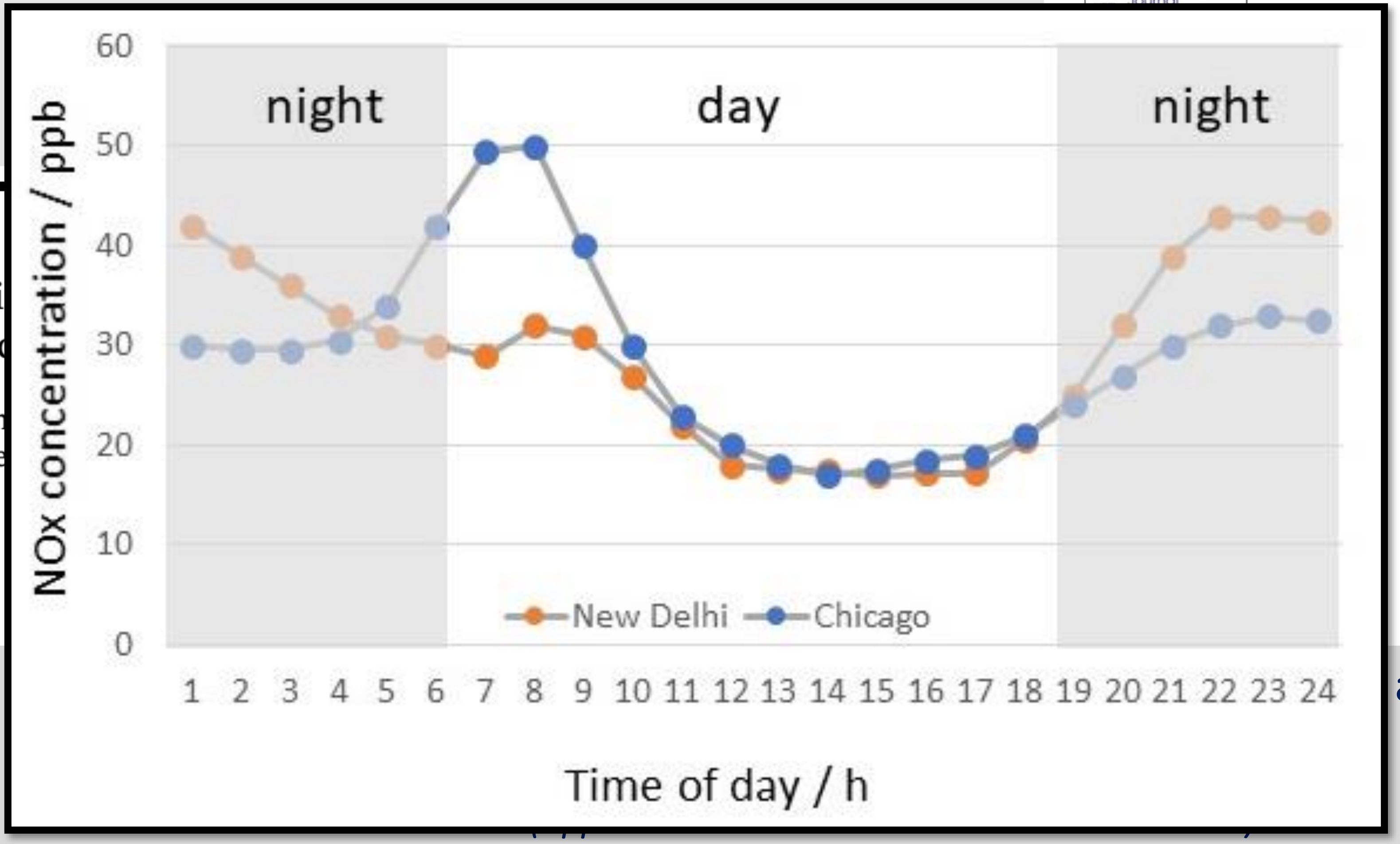
Aqueous misci
De-NO_x photoc

Adrián Pastor [a], Ch
Jean-Charles Buffe



a highly efficient De-

Graphene quantum dots/NiTi layered double hydroxide heterojunction as a highly efficient De-NOx photocatalyst with long persistent post-illumination action.

(Appl. Cat B: Environmental – revision submitted)

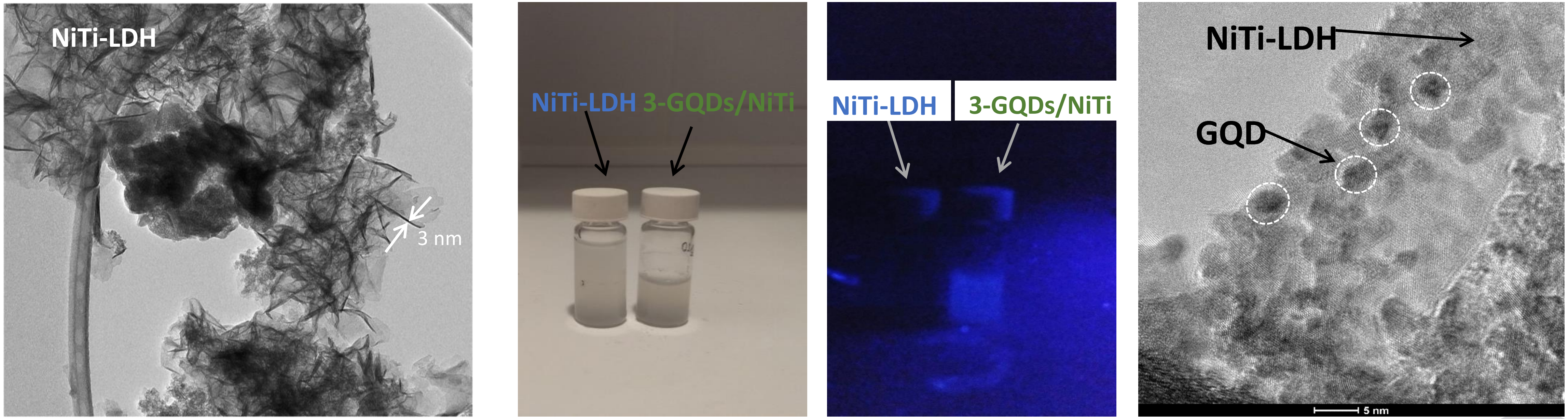
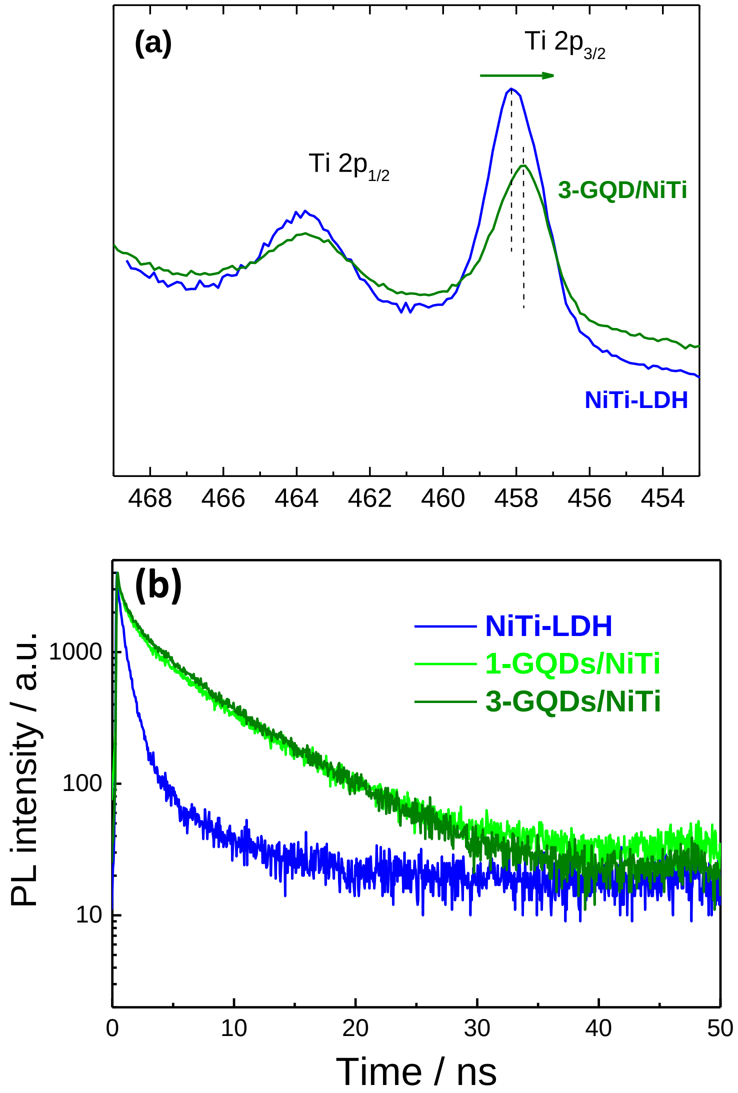
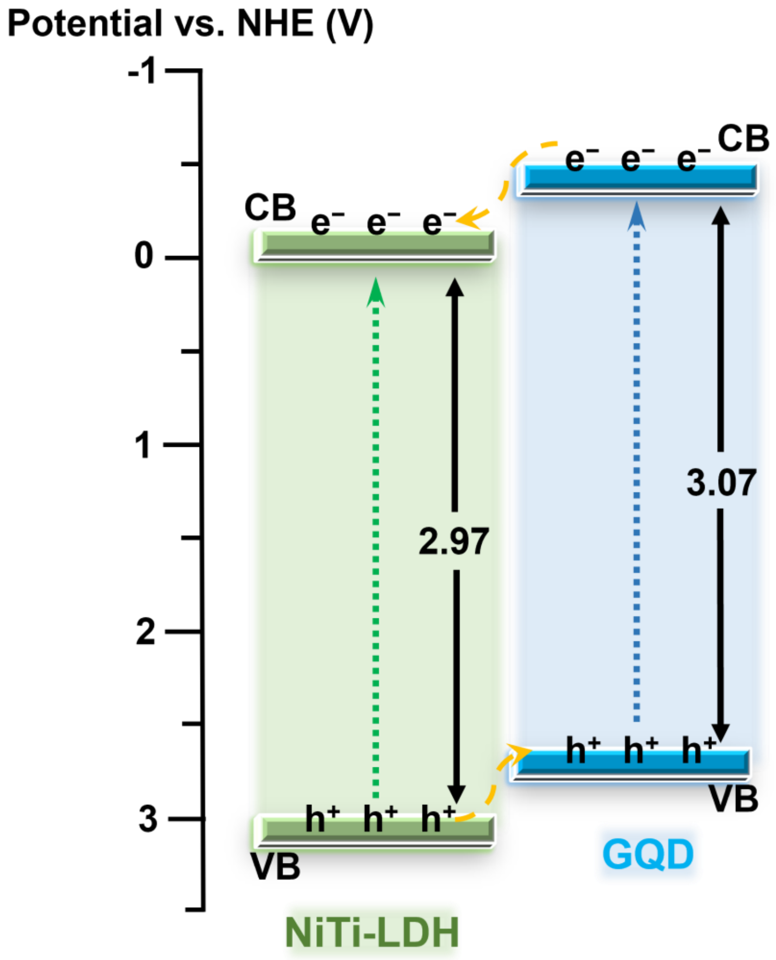


Figure 2: NiTi-LDH nanosheets (left). NiTi-LDH and GQDS/NiTi dispersions in light and dark conditions (center). HRTEM image for 3-GQD/NiTi sample (right) .





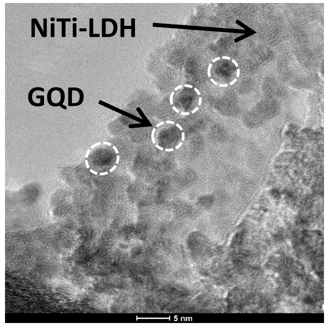


Figure 3: (a) XPS Ti 2p and (b) Time decay of the PL signals for NiTi-LDH and GQDs/NiTi samples.

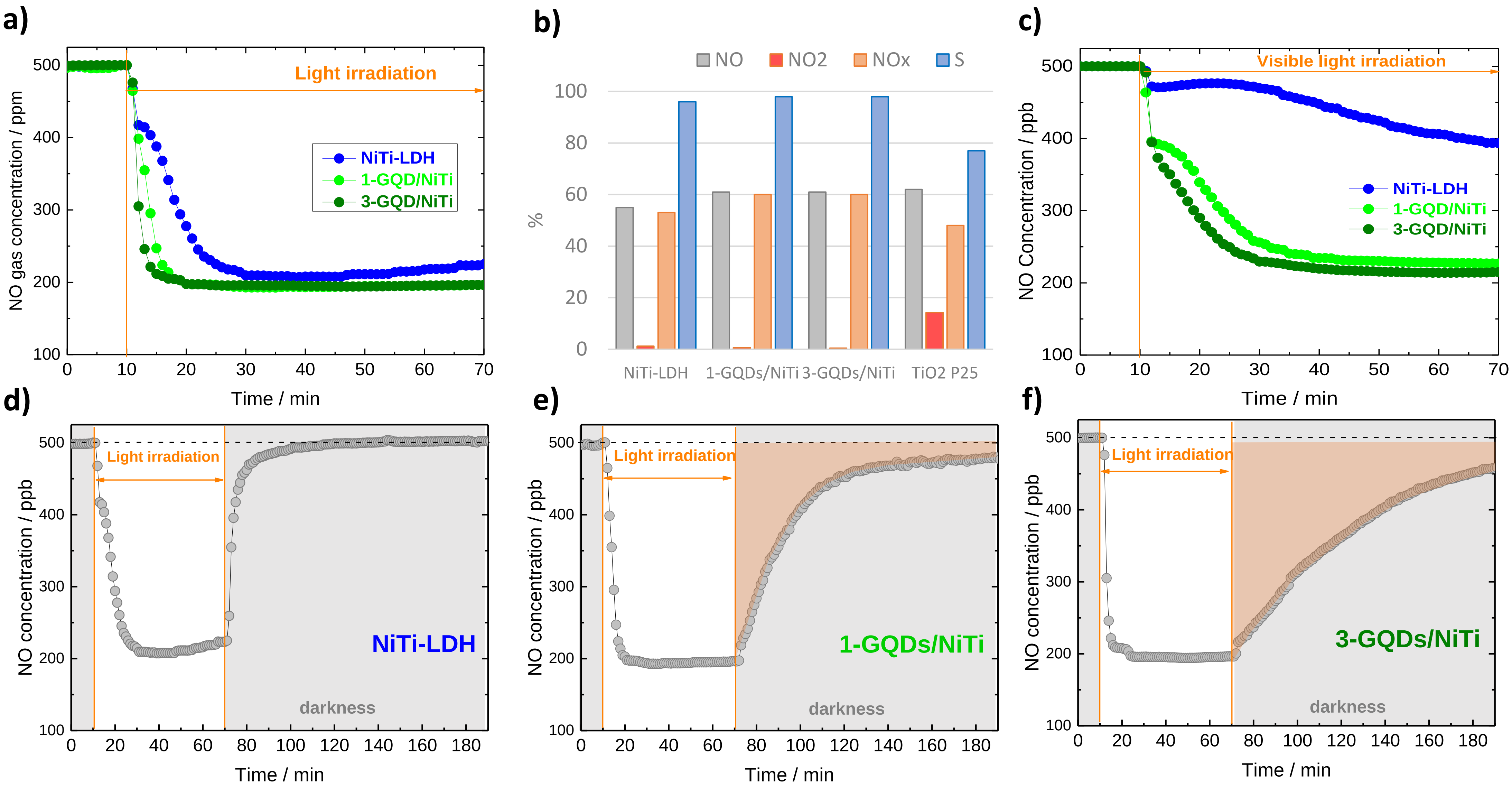


Figure 4: (a) Gas concentration evolution during the photodegradation of NO under (a) UV-Vis or (c) visible light irradiation on NiTi-LDH and GQDs/NiTi samples. (b) NO conversion, NO_2 emitted, NOx conversion and selectivity values (%). (e - f) Gas concentration evolution during the catalytic reaction of NO in light/dark periods on NiTi-LDH and GQDs/NiTi samples.

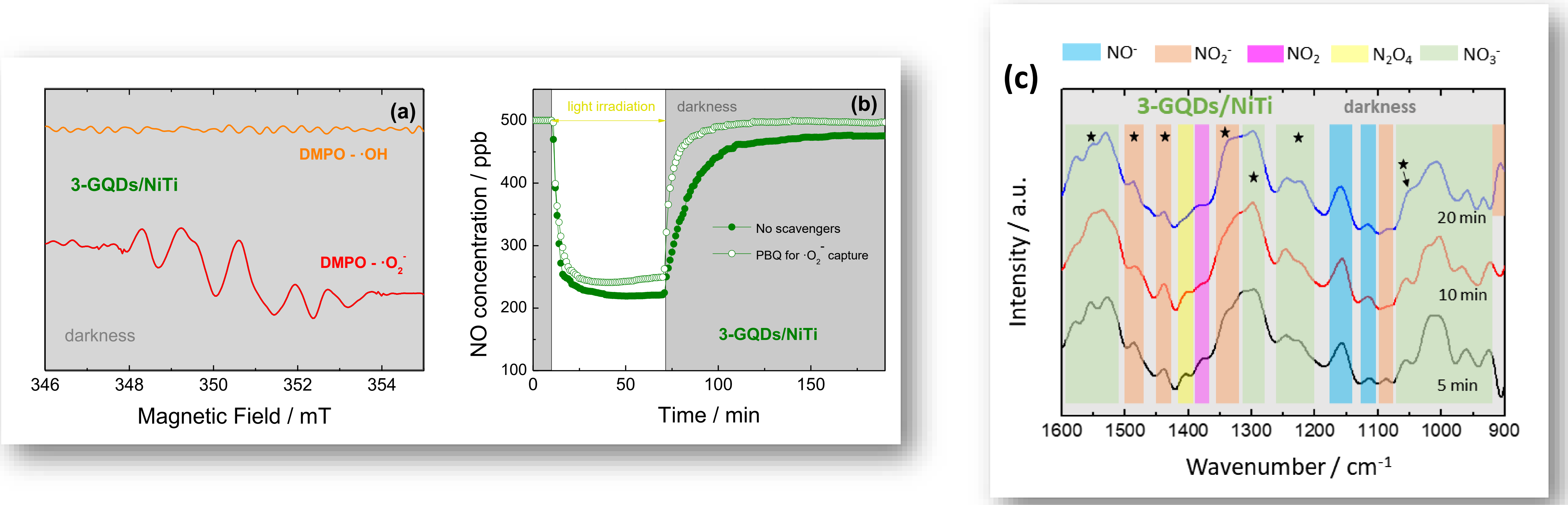
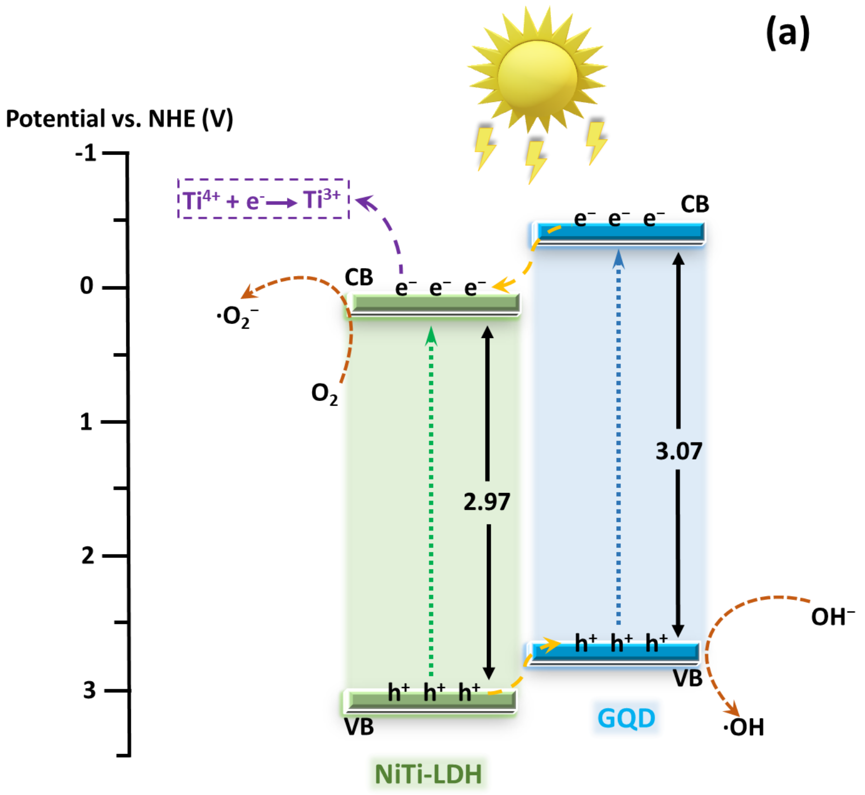
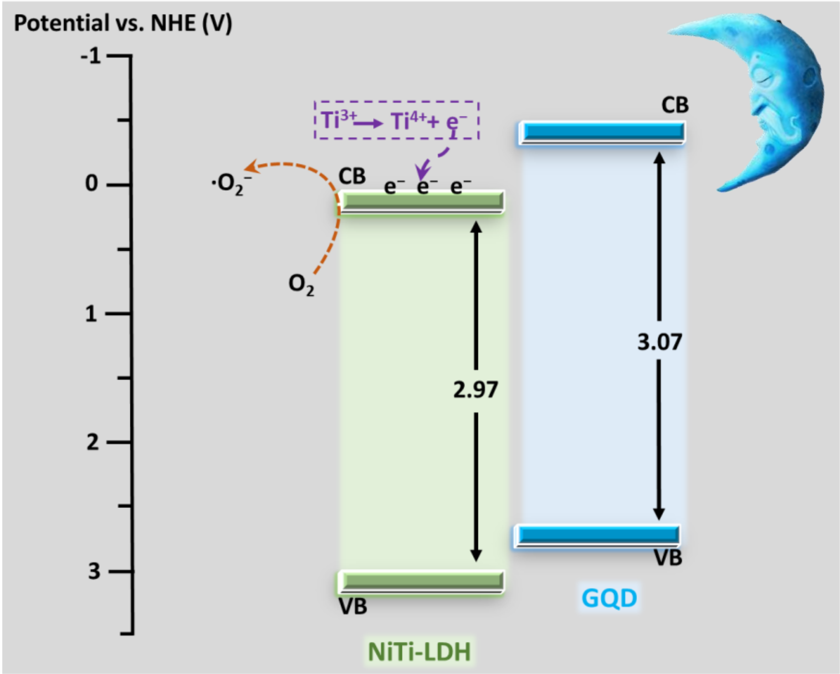


Figure 5: (a) DMPO spin-trapping EPR spectra, (b) active species trapping experiments and (c) in situ DRIFTS spectra for 3-GQD/NiTi sample. (a) and (c) measurements were done in the dark for the pre-illuminated 3-GQDs/NiTi sample.

Photocatalytic and energy storage mechanisms





Thanks for your attention!!

Visit us on: https://www.2d2denox.org/

Acknowledgements.

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