



Dra. Patricia Benito
University of Bologna
(Italy)

Abstract

H₂ and carbon production through catalytic methane decomposition over hydrotalcite-derived Fe catalysts

H₂ will play a key role in the decarbonisation to reach a reduction of GHG of 55% by 2030 and the net zero emissions by 2050 and in the REPowerEU Plan [1]. Green H₂ obtained by water electrolysis using renewable energy will be the main contributor in the H₂ economy; nevertheless, other solutions are searched to bridge the gap between the conventional steam methane reforming (grey H₂) and water electrolysis. Catalytic decomposition (or cracking) of methane (CDM) is a valuable CO_x-free hydrogen production technology [2]. The added-value is the production of carbon materials for special applications. However, the key advantage of the methane cracking, the production of solid carbon, also provokes the catalyst deactivation and clogging of the reactor, hence hampering the process implementation. In this talk, the work in progress within the framework of the Horizon Europe STORMING project to obtain low cost catalysts for the production of H₂ and carbon nanotubes (CNTs) will be presented [3]. The use of hydrotalcite-derived compounds to exploit the metal-support interaction and dispersion of Fe species in an oxidic matrix will be shown.

A moderately loaded, 20 wt.% Fe-based catalyst (FeMgAl), containing a MgAl₂O₄ spinel with Fe³⁺ species, obtained by calcination at 800°C is preferred to its counterpart calcined at 700°C with a mixed oxide (MgFeAlO_x) structure. Base-growth multi-walled CNTs are achieved by the adoption of relatively low temperatures (700°C-750°C) and activation of the catalyst under reaction conditions. Fe₃C forms as the active species, which plays a key role in the activation of CH₄.

Biography

Patricia Benito is Associate Professor of Industrial Chemistry at the University of Bologna. Her research work is currently focused on the development of catalytic processes and catalysts for the conversion CO₂ and the electrification of the chemical industry to produce CO₂-free H₂ and to valorize biomass-derived compounds. She is co-author of more than 100 articles with an h-index of 32.



Dr. Andrei Salak
Aveiro University
(Portugal)

Abstract

Low-Temperature Heat Capacity and Magnetic Anisotropy of Cobalt(II)-Aluminium Layered Double Hydroxides

Layered double hydroxides (LDH) represent a numerous family of natural 2-D materials. Due to the unique combinations of functionalities, LDH find application in such different areas as catalysis, water treatment, drug delivery, energy storage, and sensing. LDH are composed of the alternating positively charged mixed metal M^{2+} - M^{3+} hydroxide layers, in which the oxygen octahedral MO_6 are edge-linked, and the interlayers occupied by anions (A^-) and water molecules. LDH can be intercalated with different types of anions or anionic complexes, which are arranged in several different ways depending on the cation ratio M^{2+}/M^{3+} , resulting in variation of the interlayer distance.

In LDH containing at least one of Co^{2+} , Ni^{2+} , Mn^{3+} , Cr^{3+} or Fe^{3+} , the magnetic ordering occurs at very low temperatures, which makes unlikely their direct practical use. Nevertheless, since the magnetic properties of such LDH are dependent on the cation content and the interlayer distance they are of interest as potential basis for magnetic nanohybrids.

Heat capacity (C) of cobalt-aluminium LDH with the Co^{2+}/Al^{3+} ratio (n) of 2 and 3, and intercalated with NO_3^- , CO_3^{2-} and OH^- , was measured as a function of temperature between 2 and 100 K. Magnetic contribution to the heat capacity (C_{mag}) of Co_nAl LDH was extracted from comparison of the $C(T)$ dependences with the respective reduced dependences of their non-magnetic counterparts, Mg_nAl LDH. We have found that the shape of the $C_{mag}(T)$ curves reflects intrinsic differences in magnetic nature of Co_nAl layered hydroxides with $n=2$ and $n=3$.

We explored the aligning effect of magnetic field to form highly-oriented dense layers of flake-like nanocrystallites of Co_2Al LDH with the flake surfaces perpendicular to the direction of the magnetic field. This effect is an indication of the magnetic anisotropy of the LDH crystallites, which is likely to be induced by the honeycomb-type (Co-Al 2:1 cation ordered) lattice, which prevails over the statistical distribution of the cation coordinations of Co^{2+} .

Biography

Andrei Salak completed his PhD in 1994 in the Institute of Solid State and Semiconductor Physics (Minsk, Belarus) and joined the Faculty of Physics of the Vitebsk State University as a lecturer, Assistant Professor (1995) and Associated Professor (1998). Since 2002 he is a member of CICECO - Aveiro Institute of Materials and Department of Materials and Ceramics Engineering (DEMaC) of the Aveiro University (Portugal). At present, A. Salak is a Principal Researcher at CICECO/DEMaC. He specializes in crystal structure determination and characterization of physical properties of inorganic solids, particularly perovskite-like materials and layered double hydroxides. A. Salak is a co-author of more than 150 papers in international peer-reviewed journals with over 3800 citations and 3 patents. A. Salak has completed the supervision of more than 10 Master students and 4 PhD students. In 2023 and 2024, he was mentioned among the researchers in the top 100,000 (the top 2%) of the most cited (without self-citation) in the world throughout their careers and in their scientific field in the report published by Stanford University.