World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Electronic Properties Study of Ni/MgO Nanoparticles by X-Ray Photoemission Spectroscopy (XPS)

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Abstract : A lot of knowledge has been accumulated on the metal clusters supported on oxide surfaces because of their multiple applications in microelectronics, heterogeneous catalysis, and magnetic devices. In this work, the surface state of Ni / MgO has been studied by XPS (X-ray Photoemission Spectroscopy). The samples were prepared by impregnation with ion exchange Ni^{2+} / MgO, followed by either a thermal treatment in air (T = 100 -350 ° C) or a gamma irradiation (dose 100 kGy, 25 kGy dose rate h -1). The obtained samples are named after impregnation NMI, NMR after irradiation, and finally NMC(T) after calcination at the temperature T (T = 100-600 °C). A structural study by XRD and HRTEM reveals the presence of nanoscaled Ni-Mg intermetallic phases (Mg_2Ni, $MgNi_2$, and Mg_6Ni) and magnesium hydroxide. $Mg(OH)_2$ in nanometric range (2- 4 nm). Mg-Ni compounds are of great interest in energy fields (hydrogen storage...). XPS spectra show two Ni2p peaks at energies of about 856.1 and 861.9 eV, indicating that the nickel is primarily in an oxidized state on the surface. The shift of the main peak relative to the pure NiO (856.1 instead of 854.0 eV) suggests that in addition to oxygen, nickel is engaged in another link with magnesium. This is in agreement with the O1s spectra which present an overlap of peaks corresponds to NiO and MgO, at a calcination temperature T ≤ 300 °C.

Keywords : XPS, XRD, nanoparticules, Ni-MgO
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020