



P-ISSN2349-8528

E-ISSN 2321-4902

IJCS 2016; 4(1): 138-140

© 2016 JEZS

Received: 29-11-2015

Accepted: 30-12-2015

**Prince Kumar**

Extension Lecturer

M.Sc -Chemistry (Physical Chemistry), F.G.M Govt College, Adampur (Hisar), Haryana, India.

## A study on the role of metal oxides and their transition

**Prince Kumar****Abstract**

Metal oxides play a very important role in many areas of chemistry, physical and materials science. Metal oxides are formed as a consequence of co-ordination tendency of metal ions so that oxide ions form co-ordination sphere around metal ions and give rise to close packed structure. The different physical, magnetic, optical and chemical properties of metal oxides are of great interest to chemists because these are extremely sensitive to change in composition and structure. Extensive studies of this relationship leads to a better understanding of the chemical bond in crystal. The metal oxides are attracting special attention of scientists due to their easy mode of formation and multifunctional behaviour.

**Keywords:** Metal, Transition, Oxide**Introduction**

The transition metals and their compounds are used as catalysts in chemical industry and in battery industries. Besides, these compounds can be used in formation of interstitial compounds and alloy formation. The transition metals have the special properties of formation of coloured compounds and show magnetic properties. Metals of d-block elements are used for many industrial applications. They behave as catalysts, super conducting materials, sensors, ceramics, phosphors, crystalline lasers etc. Besides these they are excellent photoactive materials and work as photo-sensitizer. Mixed metal oxide (MMO) electrodes are devices with useful properties for chemical electrolysis. The term refers to electrodes in which the surface contains two kinds of metal oxides- one kind usually RuO<sub>2</sub> and IrO<sub>2</sub> desired reaction such as production of chlorine gas.

The study utilized novel Fe-Mn-Zn-Ti-O mixed metal oxides for the low temperature removal of H<sub>2</sub>S from gas streams in the presence of H<sub>2</sub>, CO<sub>2</sub> and H<sub>2</sub>O. The efficiency of Fe-Mn-Zn-Ti-O mixed-metal oxides of varying composition prepared by sol-gel methods toward removal of H<sub>2</sub>S from a gas mixture containing 0.06 vol% H<sub>2</sub>S, 25 vol% H<sub>2</sub>, 7.5 vol% CO<sub>2</sub>, and 1-3 vol% H<sub>2</sub>O was studied in the 25-100 °C range. In particular, a three times greater H<sub>2</sub>S uptake at 25°C compared with that on the commercial adsorbent was found. The work provides new fundamental knowledge that could trigger further research efforts toward the development of alternative mixed metal oxide not based on toxic.

The research characterized the removal of copper from aqueous solution using iron containing adsorbents derived from methane fermentation sludge. Iron-containing adsorbents prepared from methane fermentation sludge (MFS) were characterized by N<sub>2</sub> adsorption, NRD, SEM, EDX, pH determination and elemental analysis. The results indicated that the adsorbent obtained at 7000°C for 1 h in a steam atmosphere possessed the highest capability for Cu (II) adsorption. The Cu (II) adsorption onto the composite adsorbents in via ion-exchange with H, Ca and K ions, surface precipitation and binding with active sites on the surface of iron hydroxides at various pH values. The adsorbents can be applied to remove copper from water or soil by fixation onto the surface.

**Review of literature**

Simona and coworkers *et al.* utilized the properties of copper-based pillared clays (Cu-PILC) studied and compared with those of the analogous iron-based clays (Fe-PILC) in the wet hydrogen peroxide catalytic oxidation (WHPCO) of model phenolic compounds (p-coumaric and p-hydroxybenzoic acids) and real olive oil milling wastewater (OMW). These two catalysts show comparable performances in all these reactions, although they show some

**Correspondence****Prince Kumar**

Extension Lecturer

M.Sc -Chemistry (Physical Chemistry), F.G.M Govt College, Adampur (Hisar), Haryana, India.

differences in the rates of the various steps of reaction. In particular, Cu-PILC shows a lower formation of oxalic acid (main reaction intermediate) with respect to Fe.

Eguchi *et al.* characterized the reduction process of copper–iron spinel oxide, which is active for steam reforming of dimethyl ether after mixing with alumina and investigated by a transmission electron microscope (TEM), scanning TEM (STEM), and energy dispersive X-ray (EDX) analyzer. The catalyst preparation was started from formation of well-sintered  $\text{CuFe}_2\text{O}_4$  by calcination in air at 900 °C. After reduction of  $\text{CuFe}_2\text{O}_4$  with hydrogen at 250 °C, metallic copper grains were developed on reduced spinel surface by the phase separation from the oxide. Strong chemical interaction between deposited Cu and reduced spinel oxide was expected from their intimate interfacial contact and lattice matching.

Han *et al.* evaluated a series of Cu-Fe bimetal amid-oximated polyacrylonitrile (PAN) fiber complexes with different molar ratios of  $\text{Cu}^{2+}$  to  $\text{Fe}^{3+}$  ions prepared using a simple exhaustion method, and characterized using FTIR, DRS and XPS, respectively. They were tested as the heterogeneous fenton catalysts for rhodamine B degradation with  $\text{H}_2\text{O}_2$  in the dark and under visible light irradiation. The results indicated that Cu-Fe bimetal amidoximated PAN fiber complexes could more effectively catalyze the dye degradation in water than Fe amidoximated PAN fiber complex, especially in the dark.

Riz *et al.* checked the oxidative dehydrogenation of n-butane to butenes over iron-zinc oxide catalysts. X-ray diffraction (XRD), temperature-programmed reduction (TPR) and mossbauer spectroscopy were used to try to identify the catalytically active phase. It was found that the presence of a zinc ferrite ( $\text{ZnFe}_2\text{O}_4$ ) phase with a spinel structure yields high selectivity to butenes.

Nam and coworkers analysed the hydrogenation of carbon dioxide to hydrocarbon over iron oxide catalysts studies were carried out in a fixed bed reactor under pressure of 10 atm and temperature of 573 K. Iron oxide catalysts promoted with V, Cr, Mn and Zn prepared by precipitation method were adopted in the present study. The catalysts were characterized by XRD, carbon dioxide chemisorption and mossbauer spectroscopy. The hydrocarbons were formed directly from carbon dioxide over iron catalysts.

Rethwisch *et al.* studied supported iron oxide and zinc oxide samples as water-gas shift catalysts at temperatures from 620 to 720 K. The supports studied were  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{MgO}$ ,  $\text{ZnO}$  and Na-mordenite. The catalytic activity of all supported iron samples was significantly lower than that of magnetite ( $\text{Fe}_3\text{O}_4$ ). It is suggested that whereas magnetite functions as a catalyst via an oxidation-reduction pathway, all supported iron and zinc oxide samples operate via an associative mechanism for the water-gas shift. The catalytic activities of the supported samples decreased as the acidity of the support or the electro-negativity of the support cations increased.

Mirzaei and coworkers find out the effect of a range of preparation variables such as the precipitate ageing time and  $[\text{Fe}]/[\text{Co}]$  molar ratio of precipitation solution on the composition and morphology of iron-cobalt oxide catalysts prepared using a co-precipitation method and the optimum preparation conditions were identified with respect to the catalyst activity for the Fisher–Tropsch reaction.

Nukajima *et al.* synthesized thermally stable mesoporous  $\text{Ta}_2\text{O}_5$  by a sol-gel technique using a material having a BET surface area of  $145 \text{ m}^2 \text{ g}^{-1}$ , mesopore diameter of 3.5nm, and mesopore volume of  $0.20 \text{ ml g}^{-1}$ . The formation of thicker walls results in higher thermal stability than tantalum oxides prepared by a ligand – assisted templating method.

## Methodology

A temperature programmed desorption (TPD) study of the water and CO- interaction with the surface of gold doped iron oxide sensors is presented. TPD data has shown that CO does not adsorb in the absence of water. The adsorption of CO occurs when water is present as coadsorbate, through the formation of a surface formate intermediate. TP reaction of CO with oxygen in both dry and wet air has shown that water also promotes CO oxidation, likely via the same formate intermediate. The effect of water on the CO sensing of  $\text{Au}/\text{Fe}_2\text{O}_3$  sensors was also investigated. In the present study it is possible to develop sensors based on iron doped tin dioxide, which can detect both methane and butane (present in CNG and LPG, respectively) at a temperature at 350°C. However, the same sensors can selectively detect butane at a temperature of 425°C. The incorporation of palladium as a catalyst in Fe-doped  $\text{SnO}_2$  sensors removes the typical selectivity, and the temperature of the maximum response coincide for methane and butane.

Li-doped iron oxide thin films deposited on a porous ceramic substrate by a liquid-phase method (LPD) were investigated as humidity sensors. Large variations in the resistance, up to about 4-5 order of magnitude, were observed by changing the relative humidity (RH) between 10 and 90%. The role of Li on the response to water vapour of iron oxide thin films is discussed.

Intrinsically semiconducting oxide materials offer the possibility for highly sensitive direct thermoelectric gas sensors. Intrinsic  $\text{Fe}_2\text{O}_3$  has been chosen as a well suited candidate for direct thermoelectric gas sensors. The used temperature modulation technique combined with a regression analysis allowed a determination of the measured thermopower within 6.4 s and the possibility for self-diagnosis. These presented results shows a possible realization of fast, accurate, highly sensitive direct thermoelectric gas sensors.

Effects of iron introduction in RGTO prepared tin oxide gas sensors are presented. The films were deposited by sputtering from a tin target with the introduction of an adjustable number or iron inset. Iron content was varied in the range 0-7%. The thin films are investigated by the volt-amperometric technique for electrical and gas-sensing properties. The response of the sensors is stable and reproducible at all operating temperatures tested (200-500°C) during 3 months of operation.

The NO,  $\text{NO}_2$  and  $\text{NO}_x$  gas-sensitivity properties of Nb-doped  $\alpha\text{-Fe}_2\text{O}_3$  sintered compacts have been studied in the 0–100 ppm gas concentration and 150–300 °C temperature ranges, by d.c. and a.c. techniques. Sensors have been prepared by suspending a  $130 \text{ m}^2 \text{ g}^{-1}$   $\alpha\text{-Fe}_2\text{O}_3$  powder in a standard Nb solution in order to yield Nb/Fe atomic percentages between 0.5 and 20 at.%. Sintering has been performed at 800 °C for 2 h. The 20% doped material shows a gas sensitivity ( $S$ ), defined as  $R_G/R_A$ , where  $R_A$  and  $R_G$  are the electrical resistances in air and in the sample gas, respectively, as high as 36 at 100 ppm  $\text{NO}_2$  and 200 °C working temperature. An electrical equivalent circuit including a constant phase element (CPE), which can simulate the electrical response of the sensor in the 0–100 ppm  $\text{NO}_2$  gas concentration range, is also presented.

## Analysis

The reaction mechanisms of transition metal salts and their mixtures in molten nitrates are given. Then, the preparation of dispersed simple oxides, multicomponent system, layered intercalation hosts and supported catalysts are described. Several examples of this molten salt synthesis approach are

given with the described. Several examples of this molten salt synthesis approach are given with the objective of optimizing textural properties for catalytic applications. Management of the reaction can be obtained by modifications of the molten bath by using some dopant such as a nitrite or a carbonate. This procedure allows the dissolution of samples even at elevated temperature. The reliability interval is 5%. The electron diffraction study showed the existence of satellites, similar to those observed in the superconducting bismuth cuprates. A preliminary mossbauer study was performed.

The high  $T_c$  is emerged by doping carriers to the metallic parent phases which undergo crystallographic transition (tetra to ortho) and Pauli para to antiferromagnetic transition at 150K. The doping distance in direction of the super-current shows a strong correlation to the transition temperature.

The upper critical field  $H_{c2}$ , hydrostatic pressure dependence of superconducting transition temperature  $T_c$  and normal-state magnetic susceptibility are reported.

### Conclusion

In this study, a full factorial experimental design was utilized to access the effect of three factors on the adsorption of copper (II) and zinc (II) ions in an aqueous leachate of an industrial waste with little as adsorbent. The adsorption kinetics models, the second order model best described the data. Illite was a reasonably effective adsorbent for  $Cu^{2+}$  and  $Zn^{2+}$  from aqueous leachates of industrial waste.

The preparation of chemically modified orange peel cellulose adsorbents and its biosorption behaviors of Co(II), Ni(II), Zn(II) and Cd(II) have been studied. Effects of different chemical modifications on the adsorbent properties including different alkalis saponification. The maximum adsorption capacities of Ni(II), Co(II), Zn(II) and Cd(II) for SPA, SPA, SCA and SOA were obtained as 1.28, 1.23, 1.21 and 1.13 mol/kg and have increased by 95, 178, 60 and 130%. The Langmuir and Freundlich adsorption isotherms models fitted the experimental data best with regression coefficient  $R^2 > 0.95$  for all the metal ions. Elution efficiencies with different concentrations of HCL were evaluated.

### References

1. Noguera C. Physics and Chemistry at Oxide Surfaces; Cambridge University Press: Cambridge, U.K, 1996.
2. Kung HH. Transition Metal, Oxides: Surfaces Chemistry and Catalysis; Elsevier; Amsterdam, 1989.
3. Henrich VE, Cox PA. The Surface Chemistry of Metal Oxides, Cambridge University Press; Cambridge UK, 1994.
4. Wells AF. Structural Inorganic Chemistry 6<sup>th</sup> ed; Oxford University Press; New York, 1987.
5. Rodriguez JA, Fernandez MG. Synthesis, Properties and Applications of Oxide Nanoparticles Wiley: New Jersey, 2007.
6. Fernandez MG, Martinzes AA, Hanson JC, Rodriguez JA. Chem. Rev. 2004; 104:4063.
7. Wyckoff RWG. Crystal Structures, 2<sup>nd</sup> ed; Wiley: New York, 1964.
8. Glieter H. Nanostruct Mater, 1995; 6:3.
9. Valden M, Lai XDW. Science, 1998, 281.
10. Rodriguez JA, Liu TG, Jirsak Z, Chang J, Dvorak AJ. Am Chem. Soc. 2002; 124:5247.
11. Baumer M, Freund HJ. Progress In Surf. Sci. 1999, 61.