Significant Research Contributions of Dr. Kulamani Parida

Development of functional materials and its effective utilization as catalyst in chemical processes and pollution abatement is in the most frontier areas of research. In this regard, Dr. Parida has made significant contribution which is well reflected in the list of publications and patents and described as follows:

I. Surface and textural characterization and value addition to Indian Ocean manganese nodules, manganese nodules leached residues and low grade manganese ores.

Dr. Parida has made a detail investigation for the first time in India on the surface and textural characterization of Indian Ocean manganese nodules and also investigated the potentiality of these nodules as an oxidation catalyst. A detailed investigation on the chemical composition, surface area, pore size, pore diameter, pore size distribution, surface oxygen, surface hydroxyl groups, redox sites etc have been made by his group. The catalytic activity of natural occurring manganese nodules, modified nodules by calcination, γ-ray irradiated, acid and alkali treated, rare earth doped, lanthanum-strontium mixed and Ag_2O mixed manganese nodules for the decomposition of H_2O_2 and CO oxidation have also been investigated. Manganese nodule and its leached residues possessed good catalytic activities for oxidation of thiols to disulphides, vapour phase ketonisation of monocarboxylic acids, decomposition of volatile organic compounds (VOC), oxidation of benzyl alcohol to benzaldehyde etc. Nodules are found as an effective adsorbent for the removal of pollutants such as selenite, hexavalent chromium, phosphate and arsenic from aqueous phase. Different polymorphic forms of manganese dioxides were prepared from low grade manganese oxides by various soft chemical routes and their physico-chemical characterizations were evaluated by different techniques. The depolarizing activity was evaluated in ammonium chloride electrolyte medium. Samples prepared from carbonate route were found to be active and superior to electrolytic grade manganese dioxides.

II. Development of nano metal oxide pillared layered materials and heteropoly acid promoted mesoporous metal oxides as solid acid catalysis for fine chemical synthesis.

Manganese, chromium, iron and iron-chromium mixed oxide pillared cationic and anionic clays, titanium and zirconium phosphate were prepared by single step and multi-step ion exchange process. Various heteropoly acid promoted mesoporous metal oxides were synthesized by

impregnation method. These materials were characterized by different techniques and evaluated for acid catalysed reactions. The materials are found active and selective for nitration, esterification, isopropylation of benzene to cumene, cumene cracking to benzene and propene, dimethyl ether from methanol.

III. Design of nano metal/metal oxide pmomoted mesoporous materilas as oxidation catalyst.

Surface and textural characterization of copper, manganese, gold promoted mesoporous silica and titania, prepared by novel methods were performed by different techniques and evaluated for industrially important oxidation reactions. Nano CuO-MCM-41and MnO-MCM-41 is found active and selective for oxidation of benzene to phenol and amination of benzene to aniline. Nano gold promoted mesoporous titania showed extraordinary activity for carbon monoxide oxidation at room temperature.

IV. Development of treatment processes for the removal of hexavalent chromium from mine water.

Removal of hexavalent chromium from chromite mine water and chromo-chemical industries effluent is one of the challenging environmental problems. In this context, Dr. Parida's group have developed adsorption, photocatalytic and electrolytic reduction processes for the treatment of chromite mine water containing appreciable quantities of Cr (VI).

1. Adsorption processes.

Developed adsorption processes for removing Cr (VI) from mine water and industrial effluents using various adsorbents such as manganese nodules, different polymorphic forms of iron oxyhydroxides, red mud, anionic clays etc. The adsorption process was developed taking into account the pH of the solution, adsorbent load, Cr(VI) concentration, time, temperature and presence of other anionic species.

2. Photocatalytic processes.

Photocatalytic reduction of Cr(VI) to Cr(III) using photocatalysts such as titania, modified titania, titania pillared zirconium phosphate and titanium phosphate using UV and under solar

light has been carried out as a function of time, pollutant concentration, catalyst loading, pH, sacrificial electron donors etc to optimize the process parameters.

3. Electrolytic reduction processes.

A process for the electrolytic reduction of carcinogenic Cr(VI) pollutant in mine water has been developed. A demonstration plant has been set up at Sukinda chromite valley to treat 360 litres of mine water per second for converting Cr(VI) to Cr (III).

V. Development of processes for the removal of pollutants from industrial effluents.

Dr. Parida has worked extensively on abatement of industrial pollution adopting adsorption and photocatalytic process. In this context they have synthesized various adsorbents and photo catalysts, made detail investigation on the physico-chemical properties and evaluation of adsorption/photocatalytic activity.

1. Adsorption processes

The process on the "Removal of selenite from drinking water using ferrihydrite" by Parida et al. has been selected as the best demonstrated available technology (BDAT) for selenium removal from waste water solution by U.S. EPA. Their work on defluoridation of drinking water by using nanocrystalline anionic clays is widely accepted as a proven process.

2. Photocatalytic processes

Removal of dyes and phenolic compounds from industrial effluents by most economical route is the demand of the day. In this context, he has developed photocatalytic processes using various semiconducting materials for the conversion of these compounds to lesser harmful products using abundantly available solar light and various photocatalysts.