

Abstract of the seminar on CATALYTIC AND ELECTROCHEMICAL EXPLOITATION OF POLYOXOMETALLATES

Polyoxometallates are cluster compounds with multiple metal centres with molecular compositions. Molecular systems possess unique functional behaviour usually controlled by the reduction potential of the central central ion modulated by the surrounding species. However, polyoxometallates though possess this unique property; the modulation of this parameter is more facile and extensive, thus imparting exceptionally versatile electron transfer properties to these systems. These systems normally have parallels to the molecular systems, but at the same time, can also make a step-wise manifestation of the redox property which can be exploited for a series of reduction oxidation cycles and even these can also be carried out selectively in systems with multiple species. The objective of this presentation is to show how this special feature of the polyoxometallates can be exploited for a sequential design and fabrication of composite systems which can be exploited as electrode materials in energy conversion devices.

Polyoxometallates are also Bronsted acids in some sense since they possess free protons like mineral acids but they are caged in a very protective environment and hence their release has certain specialties different from that of the mineral acids. The possibility of exploiting this difference has been demonstrated by using as acid catalysts for two organic reactions of synthetic and materials interest.

The composite systems designed and fabricated using the redox properties of the polyoxometallates have been examined for methanol oxidation and oxygen reduction reactions which have relevance for electrochemical energy conversion devices. The electrochemical methanol oxidation is usually impaired by the adsorbed CO species (intermediates) and how this in situ inhibition of the reaction can be controlled or limited by the use of polyoxometallates will be examined in this presentation.

The oxygen reduction reaction (ORR) consists of multiple steps and hence promotion of these steps especially the conversion of peroxide species is relevant to this reaction. The nano-metallic systems with polyoxometallates form composite systems which appear to be favourable for this conversion and hence exhibit enhanced electro-catalytic activity for oxygen reduction reaction.

The presentation thus attempts to demonstrate the exploitation of the unique properties of polyoxometallates wherein molecular behaviour coupled with properties associated with condensed systems will be examined with appropriate application potential in mind.