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Foreword

As mass spectrometry continues to develop and mature, its scientific applications continue to expand. A recent new frontier lies in the important field of catalysis. The handle on ions provided by various mass spectrometric techniques allows an in depth study of a surprisingly large number of fundamental aspects of catalysis not normally accessible to investigations of neutral systems and this depth and breadth is nicely illustrated by the collection of papers in this Special Issue on Ion Catalysis.

Attention is drawn in this Special Issue to the catalytic role of ions in the unimolecular rearrangement of neutral $NH_2O^\bullet$ via a 1,2-H shift and to the catalytic role of neutral water in the conversion of the molecular adduct ion $HOMg^+/CO_2$ into the magnesium bicarbonate ion Mg^+O_2COH (a gas-phase solvent effect!). Also, magnesium hydride anions are shown to dehydrate formic acid in a two-step catalytic cycle.

Both bare and ligated atomic cations are shown to be effective in the catalysis of neutral chemical reactions. Nitrous oxide is shown to be reduced by CO in the presence of Fe^+ attached to benzene, although CO can also act to poison this catalytic cycle. The reported measurements of the catalytic oxidation of ethylene with N_2O mediated by atomic alkaline-earth metal cations mimic an important industrial catalysis and is thoroughly analyzed with computations. Both experiment and theory have been applied in an exploration of the uptake of CO by anionic gold oxide clusters, $Au_nO_m^-$ ($n \geq 4$), which is preferred with clusters containing odd numbers of oxygen atoms.

C–H bond activation in methane by ions in the gas phase continues to attract interest and be investigated because of the technologically important oxidation of methane to methanol. Electronic and thermochemical details are reported for the C–H bond activation by the bare atomic Hf^+ cation. In contrast, strong fluctuations observed in the size-dependent reactivity of anionic and cationic platinum clusters with up to 24 atoms are taken to serve as a fingerprint of heterogeneous surface catalysis. C–H activation in propane is explored with protonated hydrogen peroxide and a remarkable regioselectivity is reported for the hydride abstraction.

A convenient new use of electrospray sources in the generation of catalytically active gas-phase ions is illustrated with the formation of iron oxide and hydroxide cations from an aqueous iron(III) nitrate solution. Finally a new experimental setup is reported which uses mass selected gas phase gold and silver cluster cations to deposit well-defined neutral metal clusters on a well-defined semiconductor surface. This approach promises to allow a critical examination of the influence of cluster size on heterogeneous catalytic activity and so to "unravel the intricacies of metal particle catalysis".

We thank all authors for their contributions to this Special Issue. The 11 papers together provide a representative cross section of current research activity in the application of mass spectrometry to catalysis and provide an informative overview that will be of general interest.

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