



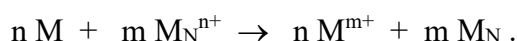
Galvanic replacement processes in electrocatalysis and metal ion removal applications

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Galvanic replacement is the spontaneous replacement of surface layers of a metal, M, by a more noble metal, MN, when the former is treated with a solution containing the latter in ionic form, according to the general replacement reaction:



The reaction is driven by the difference in the standard potential of the two metals and to avoid parasitic cathodic processes such as oxygen reduction and hydrogen evolution, both oxygen levels and the pH should be optimized. The resulting bimetallic material can in principle have a MN-rich shell and M-rich core (denoted as MN(M) hereafter) leading to a possible decrease in noble metal loading and the modification of its properties by the underlying metal M.

This lecture reviews a number of electrocatalytic materials prepared by galvanic replacement in our laboratory as well as a case that the process leads to metal ion removal from a solution in contact with a metal surface. In more detail, catalysts for fuel cell, electrolysis and electrosynthesis reactions are discussed: Pt(Ni) and Pt(Co) for oxygen reduction, Pt(Cu) and Pt(Ni) for methanol oxidation, Pt(Ni) and PtAu(Ni) for borohydride oxidation, Ir(Ni) and IrO₂(Ni) for hydrogen and oxygen evolution respectively and Ag(Ni) for benzyl-bromide reduction. The various methods (electrodeposition, electroless deposition, photodeposition) of depositing the precursor metal M on the support material as well as the various options for the latter (C, TiO₂, WO₃) are reviewed. Finally, the case of Ag ion biocide depletion from potable water, stored in stainless steel tanks and used in space missions, is interpreted as a galvanic replacement process occurring at the container walls.

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