

NEW CATALYTIC SUBSTRATES FOR FUEL CELLS BY ELECTRODEPOSITION

C. Zafferoni^a, M. Innocenti^{a,b}, A. Lavacchi^b, F. Capolupo and M.L Foresti

a: Department of Chemistry, University of Florence, via della Lastruccia 3, 50019 Sesto Fiorentino (FI), Italy

b: Institute of Chemistry of OrganoMetallic compounds ICCOM-CNR, via Madonna del Piano 10, 50019 Sesto Fiorentino (FI), Italy.

e-mail: claudio.zafferoni@unifi.it

The development of a durable, low cost, high performance and Pt-free cathode electrode (catalyst and support) usable against the Oxygen Reduction Reaction, is probably the most important and hard challenge for the practical and competitive commercialization of fuel cells. Not less importantly, the oxygen evolution reaction (OER) plays an important role in applications directed to energy saving, either for the possibility of recharging air based battery or in water splitting. In spite of the many attempts made in the last decade to create Pt-free catalysts for low temperature air cathodes, Pt remains the catalyst of choice at least for acid-based fuel cells. On the other hand in alkaline fuel cells, where the flexibility concerning the cathode catalyst is much larger, Pt-free catalysts like Ni, Ag, Co can be used. Even if these metals should not be considered non-precious metals, electrodeposition represents a good method for controlling and limiting the amount of deposited metals through either the use of the Faraday's law or the use of self-limiting phenomena such as those involved in underpotential deposition (UPD). On this ground, a good compromise between metal cost and catalyst performance of the catalyst could be the use of small quantities of catalysts and the development of new methods able to modify the structure of the deposited metals increasing the number of active sites. In this way, a good compromise between the cost of materials and the performance of the catalyst could be the use of small quantities of catalysts and the development of new methods able to modify the structure of the deposit increasing the number of active sites as recently proposed in literature and denoted as Electrochemical Milling and Faceting (ECMF)[1]. Following a similar approach we have studied the catalytic properties of small (3-17 $\mu\text{g cm}^{-2}$) quantities of silver microparticles electrodeposited on glassy carbon electrodes before and after an electrochemical oxidative/reductive protocol in alkaline media. Such an approach, which involves the formation and subsequent reduction of silver oxides, has resulted in more effective catalysis for the ORR. The modification of the surface active sites, their morphological properties (surface roughness) and their catalytic performance in ORR will be properly discussed.

[1] Y. X Chen., A. Lavacchi, S. P. Chen, F. Di Benedetto, M. Bevilacqua, C. Bianchini, P. Fornasiero, M. Innocenti, M. Marcello, W. Oberhauser, S. G. Sun, F. Vizza, *Angewandte Chemie International Edition*, 51 (2012) 8500