PO3036

# Plasma techniques to overcome DMFC issues: High surface area catalyst supports and Pd films as efficient crossover blocking barriers

Andrea Perego[1], Andrea Monti[2], Giorgio Giuffredi[2], Andrea Bisello[2], Andrea Casalegno[2], Fabio di Fonzo[1]

[1]Istituto Italiano di Tecnologia@PoliMi, Milano, Italy [2]Politecnico di Milano, Department of Energy, Milano, Italy

andrea.perego@iit.it

It is by now common knowledge that the large-scale commercialization of Direct Methanol Fuel Cell technology (DMFC) by technology aspects, such as anode kinetics and methanol crossover.
In this contribution, we report two solutions that aim to solve, or at least mitigate these negative aspects.For the first, we present a new titanium-based catalyst support with self-assembled, hierarchical mesoporous nanostructure, grown by Pulsed Laser Deposition. By controlling the gas dynamics of the nanoclusters-inseminated supersonic jet, the resulting impaction deposition conditions, and consequently, nanostructures morphology can be tuned. We demonstrate, that with our technique, a conductive ceramic such as TiN, can be nanostructured in order to maximize surface area while controlling the porosity and the morphology of the material down to the nanoscale, in order to maximize Pt utilization.
The second solution here reported heads towards the reduction of methanol crossover through the polymeric membrane during DMFC operation. Due to its affinity with water, methanol crosses the membrane, oxidizing at the cathode side, leading to energy losses and fuel waste. To overcome this, a compact Pd film, with good proton transport properties but able to block methanol flux, was deposited on top of a thin Nafion XL® membrane (25.7 μm) by means of DC sputtering.With an efficient way to block the crossover, it could be possible to increase the methanol concentration in the solution, and consequently improve the cell performances along with the efficiency, filling at least partially the gap to large-scale commercialization of the technology.

**Keywords**
DMFC
Methanol Crossover
Methanol oxidation
PLD
DC sputtering