Membrane-electrode assembly optimization for polymer electrolyte membrane electrolysers

Cemmi A.[*1] *, Pozio A.*[1]*, Serra E.*[2]*, Pasquali M.*[3]

ENEA Casaccia Research Center [1]*TER,* [2]*FIM-MAT-TEC, Via Anguillarese 301, 00123 S.M. di Galeria, Rome (Italy);* [3]*ICMMPM Dept., Faculty of Engineering, La Sapienza University, Via del Castro Laurenziano 7, 00161 Rome (Italy)*

In future low-carbon economies, electrolyser technology could provide a central solution to meeting both the power management needs of the electricity sector and the need of the transport and industrial sectors for low or zero carbon fuels.
Nowadays, despite electrolysers technology is by now well-established, the general research challenge is to maintain as high a conversion efficiency as possible and to improve more their performances, while achieving a much lower costs.
In this work, materials involved in polymer electrolyte membrane electrolysers (PEME) for hydrogen production have been developed and characterized. In particular, a procedure for the preparation of membrane-electrode assemblies (MEAs) has been tested and optimized, giving good results in term of current density values (about 90 $mAcm^{-2}$ with 3 $mgcm^{-2}$ Pt loading).
Platinum nanoparticles are chemically reduced within a Nafion™ cationic membrane, achieving a high electro-catalyst utilization. A solution containing $Pt(NH_3)_4Cl_2$ 10^{-2}M at room temperature is used to obtain surface membrane Pt impregnation: a reproducible reduction process of the noble metal was carried out placing the cationic membrane in a $NaBH_4$ solution. The method allow to prepare Pt catalyzed membrane showing strengthened bonding between the electro-catalyst and the polymeric membrane and a porous structure allowing easy gases diffusion. For comparison, gas diffusion electrodes are prepared with Pt/C commercial catalysts and the corresponding MEAs are also tested.
Chemical analysis, electrochemical impedence spectroscopy (EIS), FEG-SEM technique and electrolysis measurements are used to determine the characteristics of Pt deposits and the influence of chemical deposition method on the morphology.

*Corresponding Author: Alessia Cemmi; Tel: +39630483169; Fax: +39630486357;
e-mail address: alessia.cemmi@casaccia.enea.it