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ABSTRACTS

Comparison of High Surface Pt/C Catalysts by XRD and Cyclic Voltammetry

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Polymer Electrolyte Fuel Cells, PEFCs, could provide, in a near future, a primary power source for terrestrial electrical vehicles fed with reformed hydrogen-rich gas, thanks to the high power density achievable at low temperature ($70 \div 90$ °C). The direct evaluation of various catalysts for their activity in the gas diffusion electrodes (GDEs) of PEFCs is, however time consuming and expensive: hence it would be useful to devise a simple half-cell technique, which could mimic the complete polymer electrolyte fuel cell. Platinum nano-particles dispersed on high surface carbon were prepared by reduction of chloroplatinic acid solution using sodium formiate. The real platinum metal surface area was evaluated by XRD and cyclic voltammetry on a disk electrode coated with a thin porous layer. A detailed procedure for comparing high surface Pt/C catalysts was pointed out. All XRD patterns clearly shows the five characteristic peaks of face centred cubic crystalline Pt namely the (111), (200), (220), (311) and (222). The average crystallite size (3-6 nm) was calculated from the broadening of XRD peaks using the Williamson and Hall method to separate strain and size contribution. The crystallite size is related to the area of coherent diffraction and, in general, can be smaller than the true particle size. The crystallite size of sample was function of the concentration of reducing agent. There was a certain percentage of undetectable non crystalline Pt; this metal may be aggregated in small cluster with high catalytic activity. The line profile of some sample was characteristic of a bimodal crystal size distribution. Cyclic voltammetry was employed to obtain the electrochemical active area of the different catalysts by measuring the coulombic charges for hydrogen desorption (Q_H). The presence of a high fraction of not XRD detectable platinum particles (diffusion scattering and/or amorphous platinum) can justify this difference in surface area between some samples. In conclusion the following considerations can be drawn: