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One-step flame synthesis of cathode catalyst nanoparticles supported on stable oxide material – example of Pt on ATO

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In the present work one-step flame spray pyrolysis (FSP) is applied to produce Pt nanoparticles supported on Sb-/Nb-doped tin-based oxide materials. This synthesis procedure and the prepared materials is then evaluated for the potential application for production of and use as cathode catalysts in PEMFCs, offering high electrochemical stability and corrosion resistance for this application as compared to carbon [1-3]. Flame spray pyrolysis (FSP) is an excellent tool for pioneering development of complex nanomaterials for various applications, recently applied by e.g. SINTEF, for the synthesis of electrode materials for electrochemical applications [4]. The method is a reproducible and scalable process already being investigated by commercial powder producers [5]. The catalyst performance is evaluated both ex-situ and in-situ. In addition, PEMFC operation is carried out at different RH of gases, using electrochemical characterizations techniques, e. g. cyclic voltammetry and EIS. Finally, the durability towards start-up and shutdown operation of the Pt/ATO based catalyst coated membranes (CCM) is also investigated. The work shows that the one-step FSP Pt/ATO catalyst is highly active for the ORR. However, they still underperform in comparison to state-of-the-art Pt/C catalysts. Efforts on improving the electrode conductivity and transport properties are also carried out and show that Pt/ATO+C composites electrodes may improve the high current densities performance of the fuel cell compared to Pt/ATO alone. Pt/ATO based CCMs also show improved stability towards high voltage operation compared to conventional Pt/C catalysts.

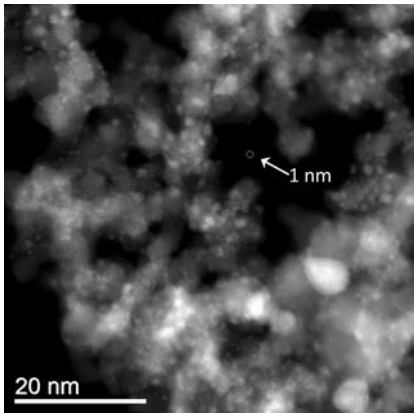

Figure 1: HAADF STEM image of ~1 nm Pt particles dispersed on ATO support prepared by one-step flame synthesis.

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