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SECM and AFM Characterizations for the Study of ORR Catalysts Electrocatalytic Activity at Agglomerate scale

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Scanning electrochemical microscopy (SECM) is at the forefront of a new generation of tools enabling to investigate the local properties of catalysts [1]. Thanks to its ability to study a very low amount of material with almost no additives such as a polymeric binder (Nafion), the intrinsic activity of catalysts gets accessible and characterizations can be performed at agglomerate scale. Herein, we propose to combine for the first time SECM with atomic force microscopy (AFM) characterizations to study the link between the catalytic activity and the agglomeration state of non-PGM (platinum group metal) ORR catalysts. SECM is performed with the redox competition mode in acidic media, following the protocol developed recently in our group [2]. AFM images are then used to determine the agglomeration state in the deposits of catalysts.

Different PGM-free ORR catalysts from the European project PEGASUS were investigated at different loadings [3]. Differences in term of dispersion, stability of the inks and adherence on the substrate were observed, which highlights the importance of adapting the ink formulation to each ink. The agglomeration states of the deposits measured by AFM enabled to explain the differences in activity measured by SECM. The performances of the catalysts were compared and the contributions of the intrinsic activity and the agglomeration state were separated. These results illustrate that our approach is suitable for the characterization of catalysts at agglomerate scale, with various applications from the benchmarking of new catalysts to the optimization of an ink formulation.

References

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