

# Effect of carbon support and metal in M-N-C catalysts on the ORR activity and stability for HT-PEMFC application

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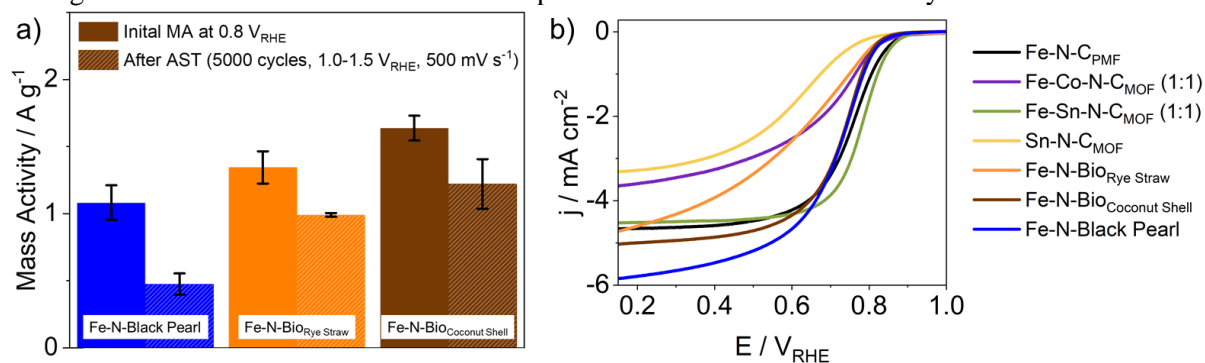
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Metal-nitrogen-carbon (M-N-C) catalysts are one of the most promising alternatives to Pt catalysts for the oxygen reduction reaction (ORR) in acidic electrolytes. Especially in the high-temperature proton exchange membrane fuel cell (HT-PEMFC) the use of M-N-Cs is attractive as they are in contrast to Pt not negatively affected by the phosphoric acid electrolyte.<sup>1</sup> However, they show lower activity and stability compared to Pt catalysts, making further optimization mandatory. The poster presentation will give an overview of different approaches to increase the activity and stability of M-N-Cs for HT-PEMFC. This includes the investigation of the effect of different carbon supports as well as the impact of single- and dual-metal sites. As carbon support for Fe-N-Cs, black pearls were compared with phosphoric acid-activated biomasses from coconut shells and rye straw. A promising stability of biomass-based Fe-N-Cs was found by rotating disc electrode measurements in perchloric acid (Figure 1 a).<sup>2</sup> While the black pearl-based Fe-N-C displays a mass activity (MA) loss of 63 %, the biomass-based Fe-N-Cs show only MA losses of around 35 % after 5000 cycles between 1.0-1.5 V<sub>RHE</sub>. However, low stability independent of the carbon support was observed in HT-PEMFC.<sup>3</sup> Next to the support-based synthesis a metal-organic framework (MOF) based M-N-C synthesis was used to investigate the effect of the metal site. Different metals including Fe, Co and Sn as single atom (SAC) or dual atom catalysts (DAC) were tested in phosphoric acid electrolyte and compared with the Fe-N-Cs from support-based synthesis (Figure 1 b). The DAC containing Fe and Sn (1:1) showed an outstanding MA at 0.8 V<sub>RHE</sub> of 4.7 A g<sup>-1</sup> compared to a commercial Fe-N-C catalyst (PMF 011904, Pajarito Powder) with an MA of 2.8 A g<sup>-1</sup>. Further studies will include the comparison of SAC and DAC stability in HT-PEMFC.



**Figure 1:** a) MAs of different catalysts before and after accelerated stress test (AST) in 0.1 mol L<sup>-1</sup> HClO<sub>4</sub> and b) ORR curves of different catalyst in O<sub>2</sub>-saturated 0.5 mol L<sup>-1</sup> H<sub>3</sub>PO<sub>4</sub> at 1600 rpm with catalyst loading of 400 μg cm<sup>-2</sup> and scan rate of 5 mV s<sup>-1</sup>.

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## References

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