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Insights on the design of highly stable noble metal-free carbon electrocatalysts for oxygen reduction reaction

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Oxygen reduction reaction (ORR) is the most challenging within those occurring during fuel cells' operation. The elementary electrochemical reaction of O_2 dissociation during ORR is very challenging due to the extremely strong O ═ O bond. Therefore, fuel cells need suitable electrocatalysts to operate efficiently. These have been traditionally based on noble metals – mostly platinum. The widespread use of fuel cell technology has thus been hindered by both the scarcity and high cost of these precious metals. Accordingly, our research focus has been directed to the development of alternatives to the use of noble metals through the development of carbon-based electrocatalysts.

Cost-effective and sustainable carbon electrocatalysts are based mostly on transition metals such as iron. Among these, single-atom electrocatalysts were shown to provide greater availability of active sites with higher reactivity compared to traditional supported catalysts. Nevertheless, designing a synthesis approach to overcome the typical lack of stability of single-atom catalysts (*e.g.*, due to aggregation and/or sintering) remains a main challenge in the field. This communication reports the main findings obtained in this quest, focusing on our contribution to advancing the design of highly stable carbon-based electrocatalysts for ORR through precise surface tuning with Fe-N active sites by employing only earth-abundant metal precursors.

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