2D carbon material with unique hierarchical pore structure

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More and more commonly we are facing the fact of the exploited fossil fuels, which are an extremely crucial part of the economy. In this particular case, scientists explore new ways to replace fossil fuels with new eco-friendly modern materials. One way to produce clean energy is synthesized electrode materials for reactions such as Hydrogen Evolution Reaction (HER), Oxygen Evolution Reaction (OER), or Oxygen Reduction Reaction (ORR). Crucial elements of the design of the catalyst are to lower to the minimum the overpotential and maximize the durability.

Metal-organic frameworks (MOF) are unique and intriguing structures due to interesting architecture – where metal oxides and organic linkers are the main components and due to the effortless way to introduce new metallic and non-metallic elements into the structures. Nickel (Ni) cobalt (Co) and iron (Fe) are the main and the most promising candidates for efficient catalysts material [1], especially when connected with nitrogen (N) and phosphorus (P) atoms. Nevertheless, during the high-temperature process of pyrolysis, the elements tend to agglomerate and form big nanoparticles covered with carbon shells – which significantly decrease the electrochemical activity of the materials. To counteract this effect, first, the carbon material ich achieved and after that is modified with new catalytically active elements mentioned above.

Al-MOF which the main component is aluminum (Al) is interesting material due to its 2D structure [2] and effortless Al removal process. Therefore the 2D carbon matrix can be successively modified to achieve intriguing structures with hierarchical pore structure and very good electrochemical performance with overpotential much lower than commercial catalyst (RuO2, Pt/C).

[1] Wei et al., Chem.Rev. 120,**21**, 12089-12174 (2020).
[2] Moreno et al., Chem.Sci. **10**, 2053-2066 (2019).