

N-Doped Carbon for the Oxygen Reduction Reaction (ORR): the role of carbon “kinks” and surface roughness

Maria K. Rybarczyk, Marek Lieder

Gdansk University of Technology, Chemical Faculty, Department of Chemical Technology, 11/12 Narutowicza, 80-233 Gdansk, Poland,

E-mail: maria.rybarczyk@pg.gda.pl

Chitosan is a natural biomaterial, which can be successfully utilized as N-doped nanocarbons precursor [1,2, 3] through in-situ doping. The carbon sheets, apart from a large specific surface area, also provide porosity, chemical inertness, low toxicity, long-term operation stability and good electrical conductivity.

Here, we demonstrate the successful synthesis method of a high-surface-area of 285 m² g⁻¹, without the template approach, and one-dimensionally structured micro- and/or mesoporous carbon material. The carbonization of chitosan leads to amorphous and partially graphitized carbon with electrocatalytic activity which can be applied as well as for the ORR applications exhibiting the high reaction onset potential and stable cycling performance in alkaline electrolytes. The nanosheets contain disordered area due to the strain imposed by the presence of nitrogen and oxygen groups in their structure. Some portion of the materials is comprised of clean well crystallized grapheme sheets. They show an interlayer distance of about 0.359 nm [2].

Our results show that besides the total nitrogen content and the type of nitrogen group (pyridinic/graphitic), also the amount of carbon ‘kinks’ and/or surface roughness strongly influence the ORR activity. The average size of the visible well-crystallized carbon is 8 x 8 nm, covering ca. 4% of the samples flat projection. The best ORR activity could be achieved if an optimal balance of surface area, textural properties as well as active site density were achieved.

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