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Insight into thermal effect on the surface properties and potentials of MnO2 (a, ß, Y) as electrocatalysts for the oxygen reduction reaction

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Abstract:
The purpose of the work is to study the thermal behavior of MnO2 (a, ß,) nanomaterials as well as their performance in oxygen reduction reaction (ORR) before/after thermal treatment. After thermal treatment, oxygen vacancies were introduced in all MnO2 nanomaterials that were confirmed by the high angle annular dark field (HAADF), electron energy loss spectroscopy (EELS), and X-ray photoelectron spectroscopy (XPS), etc. Furthermore, the conductivities of MnO2 (a, ß,) nanomaterials improved after 300 °C, particularly -MnO2 with a five-times increase over the pristine -MnO2 nanomaterials. As catalysts for ORR, the specific current density and charge transfer was improved in a-MnO2 and -MnO2 after heat treatment, which was closely related to the increased content of Mn3+ and surface absorption oxygen (Oads). However, it was observed that the ORR activity of ß-MnO2 was slightly decreased, which could be due to its lower absorption of oxygen. These results revealed that the difference in ORR activities among the three MnO2 materials can be attributed to variations in Mn3+ content, Oads content, conductivity, and the influence on morphology of thermal annealing. The overall ORR performance is influenced by a complex interplay of these factors, highlighting the importance of considering multiple aspects when studying and optimizing ORR catalysts based on MnO2 materials.