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One-Dimensional Carbon Nanomaterials and Their Application for Oxygen Reduction Reaction

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We report here the production of one-dimensional carbon nanomaterials (1D-CNMs) including carbon nanotubes (CNTs) and carbon nanofibers (CNFs) via the use of the oxidative dehydrogenation (C2H2-CO2) and the acetylene (C2H2) decomposition using a catalytic chemical vapor deposition (CCVD) method. Ni was selected as the catalyst for the synthesis due to its ability to produce different types of 1D-CNMs (CNFs and CNTs) by simple variation of the synthesis temperature. The successful synthesis was obtained via the currently used technique. CNFs were obtained at a relatively low temperature (400°C) via both reactions whereas at relatively higher temperatures (>500°C), CNTs were obtained. The electrocatalytic activity of the obtained products was investigated for oxygen reduction reaction (ORR), which is one of key reactions for the development of many technological devices including oxygen sensors, fuel cells and batteries. It was found that the carbon products exhibit good electrocatalytic activity (with the current density ranging from 1.22-5.04 mA/cm2), although they have not been incorporated with any metal catalyst and modified with any additional treatment. In addition, the products with different characteristics exhibit different catalytic behaviors. The insight obtained in this work is important for the development of non-metal electrocatalysts for ORR.

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