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Polyelectrolyte nanocomposite membranes using imidazole- functionalized nanosilica for fuel ctell applications

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The preparation and characterization of a new type of nano composite polyelectrolyte membran TM(PEM), based on DuPont® Nafion imidazole modified nanosilica (Im-Si), for Direct Methanol Fuel Cell (DMFC) applications is described. Related to the interactions between the protonated imidazole groups, grafted on the surface of nanosilica, and negatively charged sulfonic acid groups of Nafion, new electrostatic interactions can be formed in the interface of Nafion and Im- Si which result in both lower methanol permeability and also higher proton conductivity. Physical characteristics of these manufactured nanocomposite membranes were investigated by Scanning Electron Microscopy (SEM), Thermogravimetry Analysis (TGA), differential scanning calorimetry (DSC), Fourier Transform Infrared spectroscopy (FTIR), water uptake, methanol permeability and ion exchange capacity, as well as proton conductivity. The Nafion/Im-Si membranes showed higher proton conductivity, lower methanol permeability and, as a consequence, higher selectivity parameter in comparison to the neat Nafion or Nafion/silica membranes. The obtained results indicated that the Nafion/Im-Si membranes could be utilized as promising polyelectrolyte membranes for direct methanol fuel cell applications.

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Fabrication of different types of TiO_2 nanostructures and their gas sensing features

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In the last decades, metal oxides have been studied for some application areas such as solar cells, photocatalysts, and batteries. Nano-sized metal oxides are especially utulized more actively in the following fields; piezoelectric materials, optoelectronic devices, solar energy, and gas sensors. In case of fabricated metal oxide nanomaterials, the extraordinarily large surface-to-volume ratio leads to a dominant surface effect due to the increase of specific surface. Hence, high surface area results in the enhancement of the surface related properties such as catalytic activity or surface adsorption. Metal oxides such as zinc oxides, titanium oxides, and tin oxides are the most used nano-sized gas sensor. Among metal oxide-based gas sensors, TiO_2 has excellent sensing properties for various gases such as H_2, VOCs, NO_2, and CO. To improve their gas sensing properties such as sensitivity, response time and working temperature, metal oxides can be modified with different metals. In our study, TiO_2 nanotubes, nanowires and nanorods were fabricated by anodization and hydrothermal methods. Fabricated TiO_2 nanomaterials have 40-90 nm in diameters and 0.5-40 μm in length. We also achieved to modify TiO_2 nanomaterials with catalytic metal materials by some methods such as hydrothermal, cathodization and CVD. Gas sensing properties of pristine and metal-functionalized TiO_2 nanomaterials were investigated under dry air flow at the temperature range from 30 °C to 200 °C. The results revealed that the TiO_2 nanomaterials modified with metal materials exhibited excellent sensing performance to gases, especially H_2 even at room temperature, and also appropriate sensor behavior with clear response-recovery.

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