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# Defects Analysis, Components Distribution, and Properties Simulation in the Fuel Cells and Batteries by 2D and 3D Characterization Techniques

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**Abstract :** The augmented demand of the clean and renewable energy has necessitated the fuel cell and battery industries to produce more efficient devices at the lower prices, which can be achieved through the improvement of the electrode. Microstructural characterization, as one of the main materials development tools, plays a pivotal role in the production of better clean energy devices. In this study, methods for characterization and studying of the defects and components distribution were performed on the polymer electrolyte membrane fuel cell (PEMFC) and Li-ion battery (LIB) electrodes in 2D and 3D. The particles distribution, porosity, mechanical defects, and component distribution were studied by Scanning Electron Microscope (SEM), SEM-Focused Ion Beam (SEM-FIB), and Scanning Transmission Electron Microscope equipped with Energy Dispersive Spectroscopy (STEM-EDS). The 3D results obtained from X-ray Computed Tomography (XCT) revealed the pathways for electron and ion conductivity and defects progression maps. Computer-aided methods (Avizo) were employed to simulate the properties and performance of the microstructure in the electrodes. The suggestions were provided to improve the performance of PEMFCs and LIBs by adjusting the microstructure and the distribution of the components in the electrodes.

**Keywords :** PEM fuel cells, Li-ion batteries, 2D and 3D imaging, materials characterizations
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