

## Sub-zero temperature operation of polymer electrolyte fuel cells and their performance degradations

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The frozen water in polymer electrolyte fuel cells (PEFCs) may cause some problems in fuel cell systems during the winter time. The cell which suffered sub-zero temperature was experimentally compared with a reference cell which experienced the room temperature. The two cells which experienced the same number of temperature cycles were analyzed. Significant damage to the membrane electrolyte assembly (MEA) was observed after operation in sub-zero temperature. The post-analysis for the temperature cycled MEAs were conducted to check the changes in physical properties. It was found that one of the main reasons of performance degradation after freeze/thaw cycles is in the physical destruction of electrode as well as its interface by the frozen water. To confirm the above mentioned deactivation reason, 3 kinds of gas diffusion layers (GDLs) such as felt, fiber and cloth type were investigated at the same freeze/thaw conditions. It's revealed that the well contact between interfaces of materials can help enhancing the durability of PEFCs in the sub-zero condition.