Other Fuel Cell Technologies

The electrolyte defines the key properties, particularly operating temperature, of the fuel cell. For this reason, fuel cell technologies are named by their electrolyte. Four other distinct types of fuel cells have been developed in addition to the polymer electrolyte membrane fuel cell:

- alkaline fuel cells
- phosphoric acid fuel cells
- molten carbonate fuel cells
- solid oxide fuel cells

These fuel cells operate at different temperatures and each is best suited to particular applications. The main features of the five types of fuel cells are summarized in chart form.

Comparison of Five Fuel Cell Technologies

Fuel Cell	Electrolyte	Operating Temperature (°C)	Electrochemical Reactions
Polymer Electrolyte/ Membrane (PEM)	Solid organic polymer poly-perfluorosulfonic acid	60 - 100	Anode: $H_2 \rightarrow 2H^+ + 2e^-$ Cathode: $1/2\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$ Cell: $H_2 + 1/2\ O_2 \rightarrow H_2O$
Alkaline (AFC)	Aqueous solution of potassium hydroxide soaked in a matrix	90 - 100	Anode: $H_2 + 2(OH)^- \rightarrow 2H_2O + 2e^-$ Cathode: $1/2\ O_2 + H_2O + 2e^- \rightarrow 2(OH)^-$ Cell: $H_2 + 1/2\ O_2 \rightarrow H_2O$
Phosphoric Acid (PAFC)	Liquid phosphoric acid soaked in a matrix	175 - 200	Anode: $H_2 \rightarrow 2H^+ + 2e^-$ Cathode: $1/2\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$ Cell: $H_2 + 1/2\ O_2 \rightarrow H_2O$
Molten Carbonate (MCFC)	Liquid solution of lithium, sodium and/ or potassium carbonates, soaked in a matrix	600 - 1000	Anode: $H_2 + CO_3^{2-} \rightarrow H_2O + CO_2 + 2e^-$ Cathode: $1/2\ O_2 + CO_2 + 2e^- \rightarrow CO_3^{2-}$ Cell: $H_2 + 1/2\ O_2 + CO_2 \rightarrow H_2O + CO_2$ (CO_2 is consumed at cathode and produced at anode)
Solid Oxide (SOFC)	Solid zirconium oxide to which a small amount of ytrria is added	600 - 1000	Anode: $H_2 + O^{2-} \rightarrow H_2O + 2e^-$ Cathode: $1/2\ O_2 + 2e^- \rightarrow O^{2-}$ Cell: $H_2 + 1/2\ O_2 \rightarrow H_2O$