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Ceramic Based Mixed Proton-Electronic Conductor for Solid State Devices

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Background

Through a combination of unique chemical elements, the inventors have discovered a novel series of ceramics with perovskite-like structures capable of both proton and electron conduction at elevated temperatures. Some of the investigated perovskite materials tested have demonstrated excellent high temperature chemical stability in both CO_2 and H_2O environments. These ceramic based solid state materials with proton and electronic conduction at temperatures of up to 1000 ^{o}C are excellent for high temperature materials employed for fuel cell membranes, electrochromic devices, gas sensors, H_2 separation and pumps.

Development of materials with appropriate ionic and electronic conductivities is critical for alternative energy conversion and storage devices. These include proton exchange membrane fuel cells (PEMFCs), solid oxide fuel cells (SOFCs), high energy density batteries, and electrochromic displays. An important component of any fuel cell device is its membrane. Ideally, the membrane should be both chemically stable and highly conductive for ions in order to attain useful power outputs over a reasonable lifetime. By employing these perovskite-like structures, long term chemical and thermal stability can be achieved for a variety of solid state devices such as fuel cells, sensors and H_2 pumps.

Areas of Application

- Membranes for high temperature PEM-fuel cells
- Electrochromic devices
- Gas sensor
- H_2 sensor, separation, storage, pump
- Electrolyzer for H_2 production
- Hydrogenation

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Competitive Advantages

- Chemically stable at high temperatures in CO_2 and H_2O environments
- High proton conductivity at elevated temperatures
- Reduced electrocatalyst poisoning in fuel cell devices
- Durable for solid state supports
- Ease of manufacturing for various designs

Intellectual Property Status

- US 2011/0086289

Publications

- Electrochim. Acta 2010 Dec;56(1):227-34
- J. Power Sources 2009 Jan;186(2):311-9