Proton conductive solid electrolytes for high-efficiency intermediate temperature solid oxide fuel cells

Polymer electrolyte fuel cell (PEFC)

- Fuel-cell electric vehicle
- Cogeneration system for home use
- Power source for compact sized mobile device

Advantage : Compact
High power
Start up from ambient temp.

Problem

① Lower efficiency for heat waste(∼ 60C)
→ Improvement of energy conversion efficiency by intermediate-temperature operation

② Low durability
→ Clarification of degradation factor
Improvement of durability

③ High cost for cell stacks

Objective

<u>1. Development of intermediate temperature fuel cells at 300 ~ 600°C</u>

- Polyphosphate-based high proton conductive electrolytes
- Anode cermets using proton – oxide ion mixed conductors

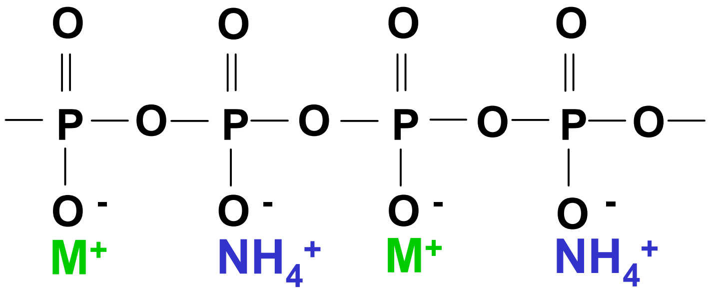
<u>2. Improvement of PEFC durability</u> (2006 ~)

- Investigation of oxygen reduction reaction mechanism and hydrogen peroxide formation on platinum catalyst

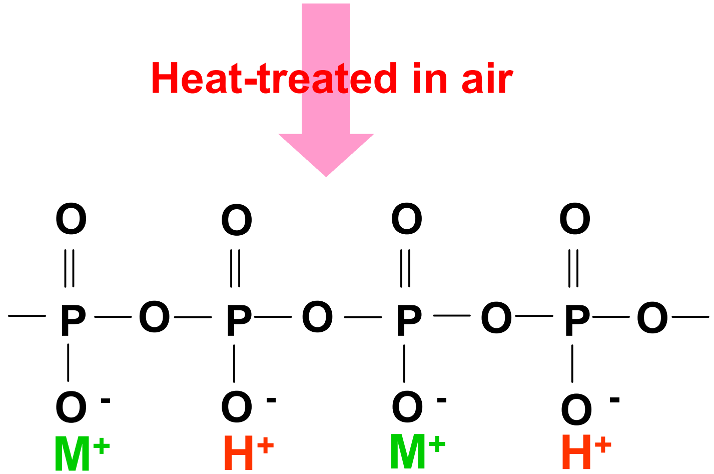
Preparation of high proton conductive solid electrolyte at 300°C

Ammonium alkaline-metal polyphosphate solid solutions

$(NH_4)_x M_{1-x} PO_3$ (M = K, Rb, Cs)



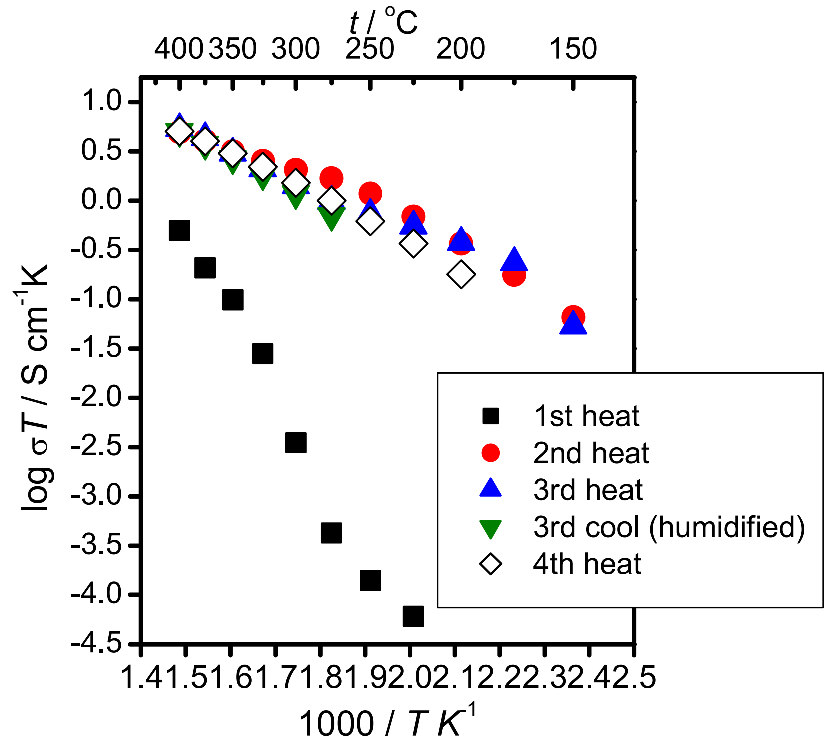
A part of NH_4^+ is substituted by M^+.



$(NH_4)_{0.20}K_{0.80}PO_3$ (x = 0.20)

High proton conductivity and thermal stability

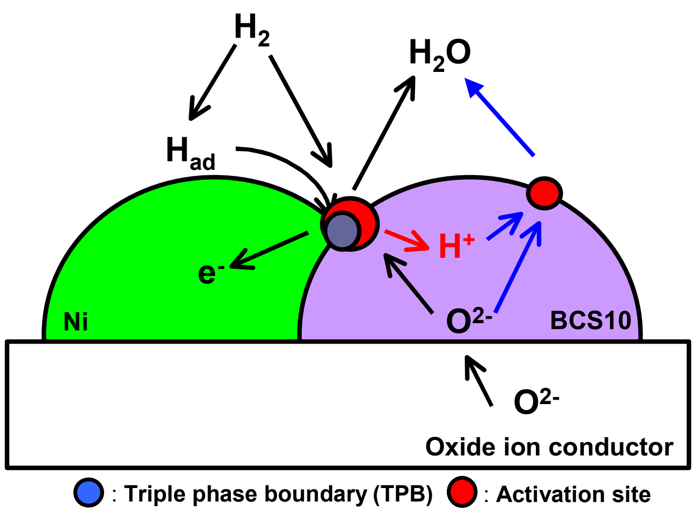
300℃	σ = 2.47 mS cm^{-1}
400℃	σ = 8.04 mS cm^{-1}



high-efficiency intermediate temperature solid oxide fuel cells (2)

Anode cermets using proton – oxide ion mixed conductors

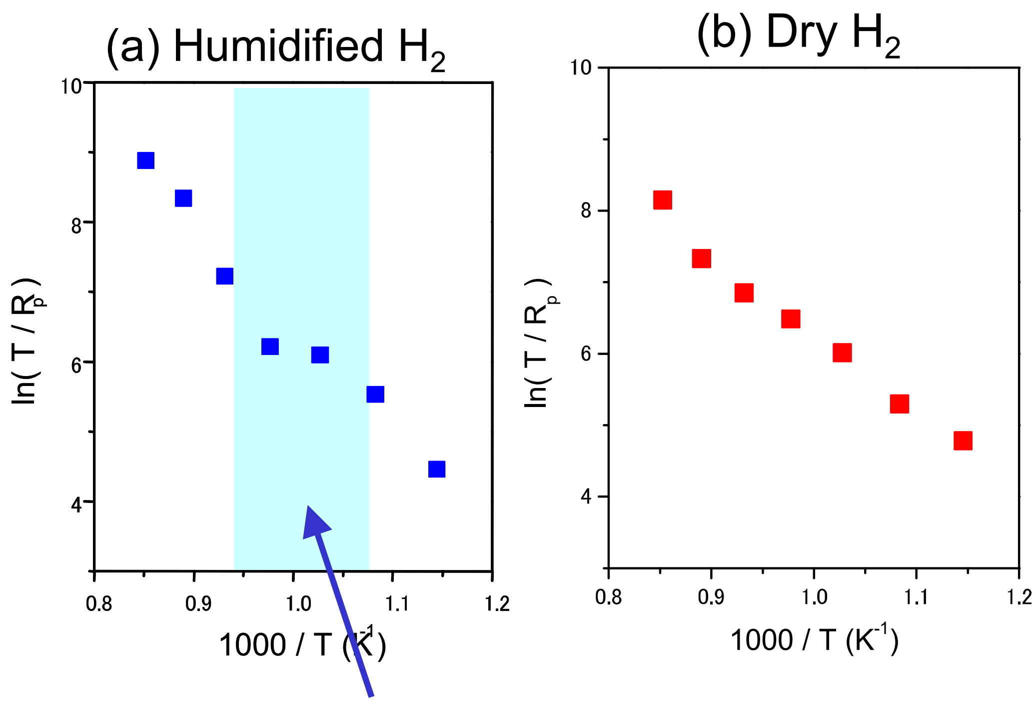
$BaCe_{0.9}Sm_{0.1}O_{3-\alpha}$ (BCS10)



Enlargement of reaction sites by proton conductivity in the anode cermet

→ High performance at low temperatures

Ni / BCS10 | LSGM | Pt



Changes in the interfacial conductivity at anode/electrolyte interface
→ Effects of proton conductivity