Electrolytic Damage in Zirconia Electrolytes

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When yttria stabilized zirconia (YSZ) electrolytes are subjected to high current densities, electrolytic damage may result. Previously, darkening and damage formation has been observed, emanating from the cathode side (the oxygen entrance side) particularly when the YSZ has been encapsulated so as to deprive the cathode from oxygen uptake.

We have observed damage emanating from the anode at high current densities on electrolytes subjected to nominal current densities of 4.5 A/cm^2 at 1045^{0}C, for extended periods. The damage develops well below the decomposition potential of YSZ.

The damage takes the form of dislocation loop and dislocation decoration, and subsequently leads to the formation of internal pore formation, inside grains as well as o grain boundaries. In the extreme, cracking along grain boundaries is observed. Example of dislocation decoration and of pore formation is shown in Figs. 1 and Fig. 2.

The damage is thought to result from the extraction of interstitial oxygen by the anode at high current densities. Transition form transgranular to intergranular fracture can also be found in YSZ and ceria-based thin film fuel cells that have operated at high power. It is possible that this weakening of grain boundaries at high current densities in fuel cells is related to the damage observed here. This may put a limit on he current densities that could be sustained by high power fuel cells.

Acknowledgement
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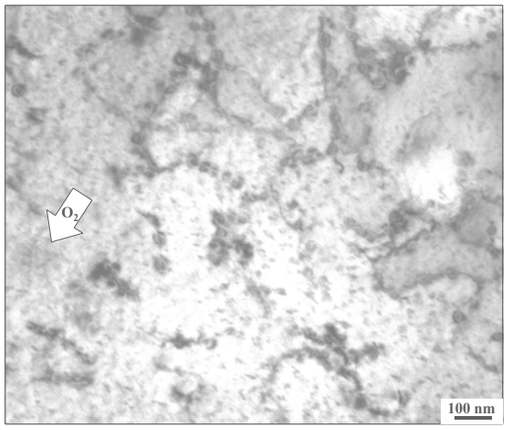

Fig. 1 Decoration of dislocations by current-induced vacancy precipitation

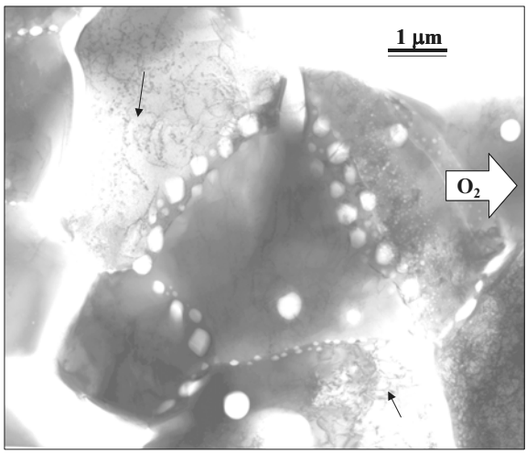

Fig.2 Current-induced grain boundary pore formation and intergranular cracking of YSZ electrolyte