Development of low operating temperature SOFCs using a zirconia-based electrolyte

Achieved 1 W/cm^2 at the operating temperature as low as 600 °C

We investigated a correlation between the microstructure of the anode of a tubular solid oxide fuel cell (SOFC) and its electrochemical property. It was found that the electrochemical property of the cell was extensively improved when the size of constituent particles were reduced in a highly porous microstructure. Based on the results, an improved tubular SOFC was prepared using a conventional zirconia-based electrolyte, Ni cermet and (La, Sr)(Co, Fe) O_3 for anode and cathode materials, respectively and it showed outstanding power density of over 1 W/cm^2 at as low as 600 °C operating temperature. Thus, a zirconia-based cell could be utilized for low temperature SOFC systems under 600 °C just by optimizing the microstructure of the anode and operating conditions.

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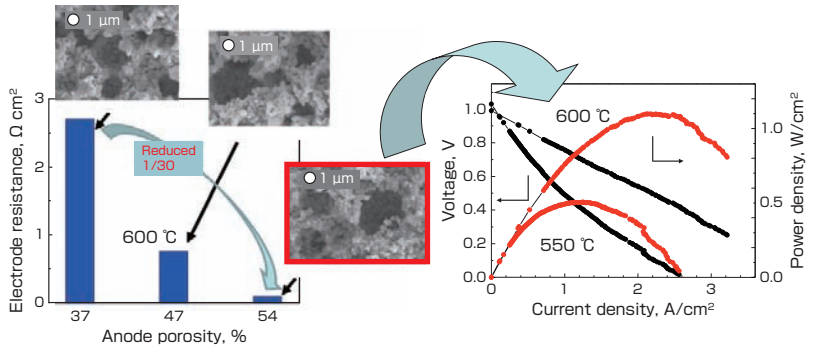

Relation between electrode resistance and anode porosity, and cell performance of the cell with 54 % anode porosity (SEM images show reduced anode microstructure.)

Development of a stabilized laser source with a sub-Hertz linewidth

Towards an ideal oscillator for the steady "ticks"

All clocks based on periodic phenomena in nature are composed of three elements: oscillator, reference, and counter. In the case of optical clocks, an ultra-stable laser is used as the local oscillator. (The reference is a narrow-linewidth transition in atoms, and the counter is an optical frequency comb.) The ultra-stable laser with a narrow linewidth and high frequency stability is essential to the operation of optical clocks, and the heart of a stable laser system is a high finesse optical cavity which must be situated in a good environment to isolate it from perturbations and should require an excellent design to be insensitive to perturbations. At the National Metrology Institute of Japan, AIST, an ultra-stable laser has been developed to drive a narrow linewidth clock transition $^1S_0$-$^3P_0$ in Yb atoms. Using very cold Yb atoms bound in optical lattices and optical frequency combs, we have been able to measure the frequency of the clock transition very precisely. The determined frequency was adopted as one of 'recommended standard frequencies' by the International Committee for Weights and Measures (CIPM).

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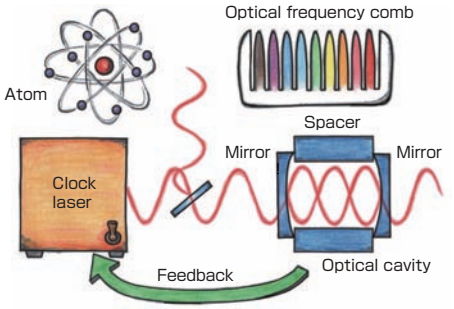
AIST TODAY Vol.10 No.4 p.21 (2010)



Frequency stabilization of a clock laser