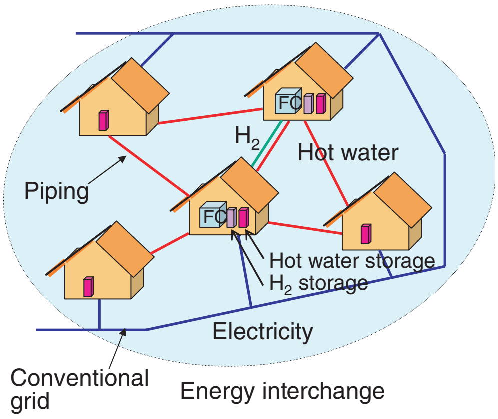
Energy Networks in the Future

The mission of the Energy Network Group of Energy Electronics Institute (EEI) is to present new concepts of future energy networks and systems, where fuel cells and hydrogen will play an important role.

The systems involve electricity, hot water and hydrogen networks and interconnection of consumers. Fuel cells will be installed in some of the consumers. Fig. 1 represents an example for residential houses.

The system provides cooperative operation of equipment and energy interchange among the houses. The CO_2 emission and primary energy consumption will be reduced significantly. Both experimental systems and PC-based simulators are being developed for quantitative analyses.



Energy system for residential houses

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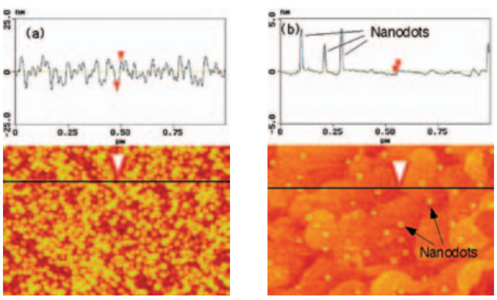
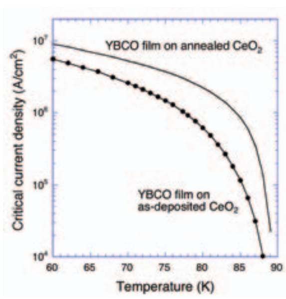
Nanotechnology and Materials Science & Technology

Improvements in Current-Density of $YBa_2Cu_3O_{7-\delta}$ Films on Sapphire Buffered with Atomically-Flat CeO_2 Having High Density of Nanodots

$YBa_2Cu_3O_{7-\delta}$ (YBCO) films was fabricated on CeO_2-buffered R-cut sapphire substrate by pulsed laser deposition. Prior to the YBCO deposition, a self-assembly process was performed where high-temperature (1025°C) O_2 annealing induces surface reconstruction of CeO_2 on sapphire substrates. The results reveal an atomically flat surface of CeO_2 film, superior crystalline quality, and the formation of a high density of nanodots on top of the CeO_2 layer (Fig.1). YBCO films grown on such CeO_2-buffered sapphire substrates had a high $T_{c\ \rho=0}$ (> 90 K) and a high J_c (> 3.0×10^6 A/cm^2 at 77.3 K and 0T, see Fig.2).



AFM images and corresponding profiles of a 36.6-nm-thick CeO_2 film grown on R-cut sapphire (a) before and (b) after high-temperature O_2 annealing at 1025°C



Critical current density J_c as a function of temperature at 0 T for two typical 200-nm-thick YBCO films on R-cut sapphire (a) with a 33-nm-thick annealed CeO_2 buffer layer and (b) with a 33-nm-thick as-grown CeO_2 buffer layer

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