로보 디스펜싱을 이용하여 직접묘화방식으로 제조된 소형 집적형 고출력 고체 산화물 연료전지

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Direct-Write Fabrication of Integrated Planar Solid Oxide Fuel Cells by Robo-Dispensing

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Key words : IP-SOFC ; Direct writing ; fuel cell ; Dispensing ; Complex layer; multilayered structure

Abstract : This research is new fabrication process for IP-SOFCs with multilayered structure that can be easily integrated in series. Direct-writing technique employs a paste delivery system mounted on a z-axis motion control stage for agile printing onto a moving x-y stage. Three-axis motion was independently controlled by a custom designed, computer aided direct-write program. The direct-write approach yields significant advantages over the conventional method for producing multilayer devices. The support substrate of IP-SOFCs was prepared with partially stabilized zirconia (PSZ) powders. The PSZ granules that had been obtained by liquid concentration process (LCP) were used to make a porous substrate with proper strength. The materials for the direct-write fabrication of IP-SOFCs were processed into the paste by dispersing each constituent powders in α-terpineol with appropriate additives. Three paste materials for YSZ electrolyte, Ni-YSZ cermet anode and LSM-YSZ cathode were used in this experiment with solid loading of 15 vol%. The syringe filled with each electrode and electrolyte paste was loaded into the computer-controlled dispensing machine. The pastes were selectively dispensed through cylindrical nozzle of 0.21mm in diameter under the air pressure of 0.1 torr onto a moving plate. First of all, the anode paste was deposited on the PSZ substrate with 4-lines which the lengths are 10 mm and the widths are 1.0 mm. The electrolyte paste was then dispensed over the anode lines to achieve layers with the lengths of 15 mm and the width of 1.5 mm. The anode/electrolyte structure patterned on the PSZ substrate was co-fired at 1350℃ in air for 3 hours. Finally the cathode layers was mounted over the electrolytes with the lengths of 10mm and the widths of 0.8mm followed by sintering at 1200℃ for 1 hours. Each line-shaped electrodes/electrolytes were well-aligned during computer-controlled fabrication process.

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