Global Thermoelectric's Integrated Cell Manufacturing of Planar SOFCs

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Global Thermoelectric Inc. is a leading developer of planar SOFC systems. Since 1997, Global has developed leading technology in thin film, high power density anode supported SOFC technology (1). Along Global's commercialization path, significant cost and performance improvements are required to transform today's SOFC technology into one suitable for low cost, mass production of small systems for multi-market applications. Global has identified the key technical issues that must be resolved to achieve the low cost commercial SOFC system of the future and is executing a carefully structured technical and engineering approach that will lead to the resolution of these issues. One of the successful examples is the development of an integrated cell manufacturing technology capable of producing high performance planar SOFCs.

For the past five years, Global has been actively engaged in integrated solid oxide fuel cell (SOFC) manufacturing technology research and development. Global's current cell manufacturing process has three major operation units for fabrication of its anode supported planar cells (Figure 1). Anode substrates approximately 1 mm in thickness are produced by a single step tape casting process. The anode, electrolyte and cathode functional layers are screen-printed directly on the green anode substrate tape. The multi-layer green cells are sintered into complete cells through a continuous co-firing process. Three generations of cell manufacturing processes evolved from the laboratory research stage to the pilot plant production stage over the past three years (2). Currently, Global is able to produce cells at a volume equivalent to 5 MW/year with greater than 90% yield. Furthermore, the production pipeline reduced from 30 days to 4 days, and cell cost per kW (direct labour and materials) has been significantly reduced by 65%. Global attributes this progress to the combination of advanced materials technologies, engineering principles and adherence to manufacturing discipline.

Global's cell performance can be attributed to the optimized microstructures developed by the integrated cell manufacturing process. Due to continuous cell technology and process development, well-engineered cell microstructure has been achieved by applying Global's current platform TSC II process (Figure 2). The optimization of the cell microstructure has reduced area specific resistance and enabled higher power densities. As shown in Figure 3, Global's cell can produce over 1.4 W/cm^2 at 750°C.

Furthermore, interfacial integrity and stability were greatly enhanced through component interactions at green stage and during co-firing. Cells made by this integrated manufacturing process (TSC II) are capable of multiple thermal cycling and electric load cycling. A long-term degradation rate of approximately 1% per 1000 hours at a current density of 0.55 A/cm^2 was demonstrated over 6000 hours of testing.

REFERENCES

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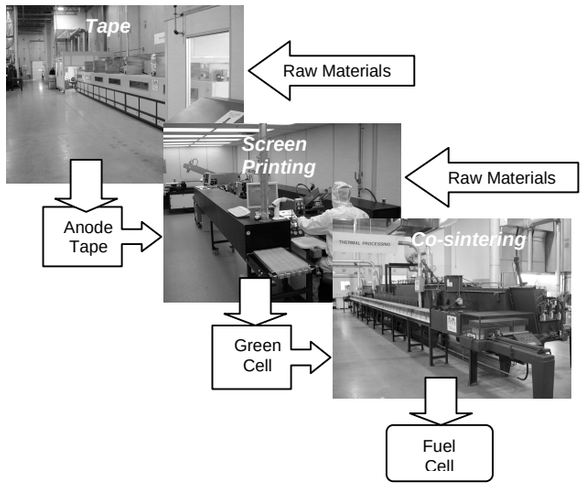

Figure 1: TSC II cell manufacturing process diagram.

Figure 2: Cross – section SEM photomicrograph of a TSC II (2002) cell (after reduction).

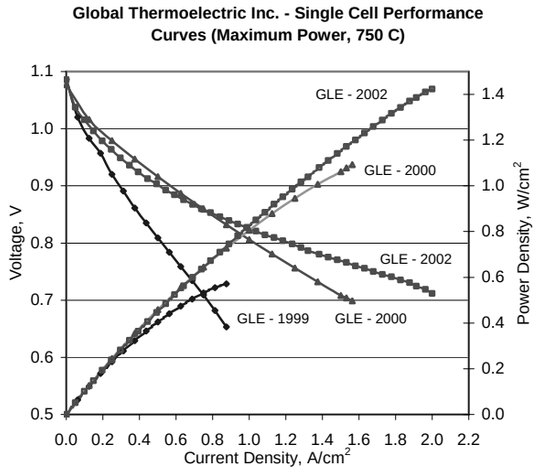

Figure 3: Cell electrochemical performance improvement.