

Current-Voltage Characteristics of SOFCs

Combining the equations for each of the phenomena involved in cell performance allows I-V characteristics to be produced. A general form, highlighting key phenomena is shown in Fig. 1.

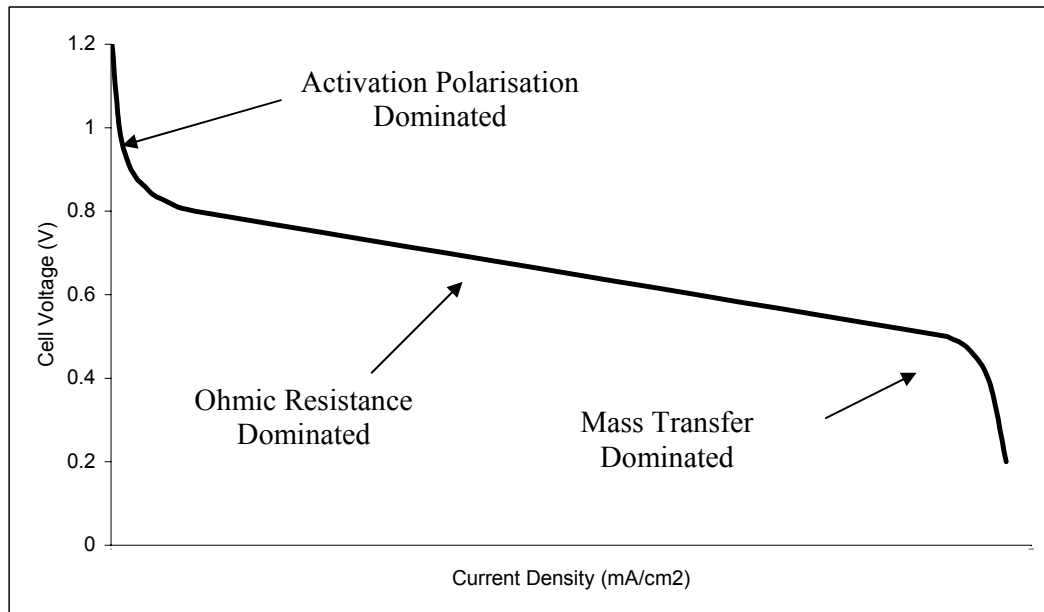


Figure 1. Schematic of SOFC I-V Characteristic

The sharp delineation of phenomenon shown in Fig. 1 is often not seen in experimental data – it depends upon the relative magnitude of cell design and operational parameters. For example, in SOFCs the high operating temperature means that activation effects are small.

Survey of Work to Date

Chan et al [1] have produced a complete polarisation model of an SOFC and supplied the relevant data for both an electrolyte and an anode supported cell. In their work the I-V curve is essentially linear, showing none of the above characteristics.

Kim et al [2] have carried out a more in depth analysis of polarisation effects, including experimental work and fitting of theoretical models to experimental data. In their work the characteristics of the curve of Fig 1. are apparent, however the explanation is not as simple as that given above (more to follow).

Preliminary results generated from my code are presented in Figs 2 & 3. These show that in the case of a substrate supported cell (thin electrodes & electrolyte) at 1273K with 50% H₂ as fuel neither activation nor concentration polarisation effects are

significant. Though not shown here, at higher fuel utilisation and/or if electrodes are thicker the diffusion limitations described above are seen.

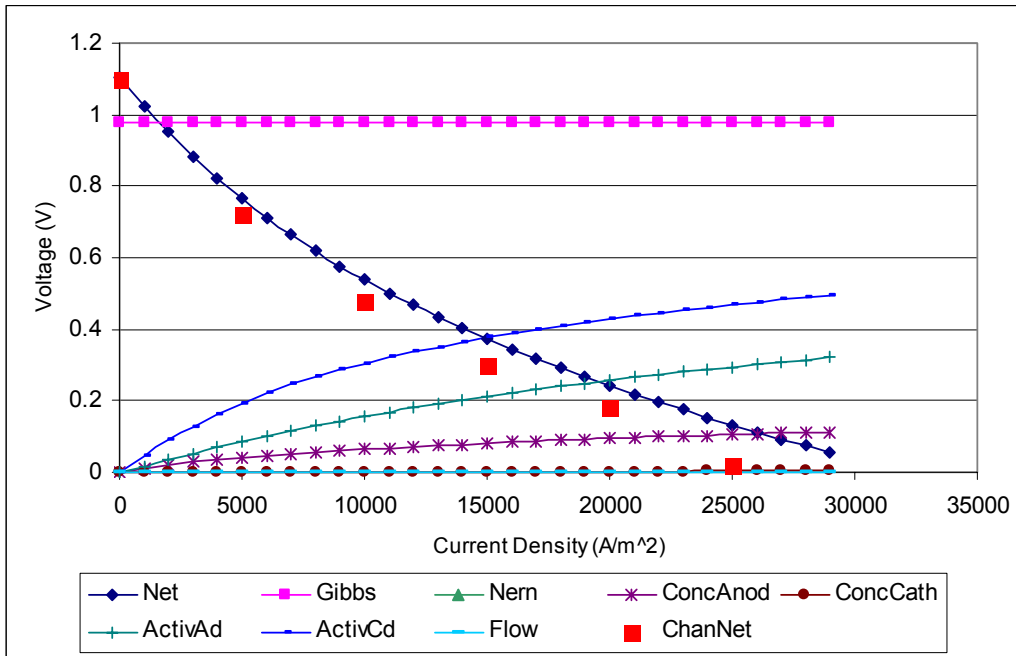


Figure 2. Current-Voltage Characteristic of Substrate Supported SOFC (1073K Fuel 97% H₂ after Chan 2001)

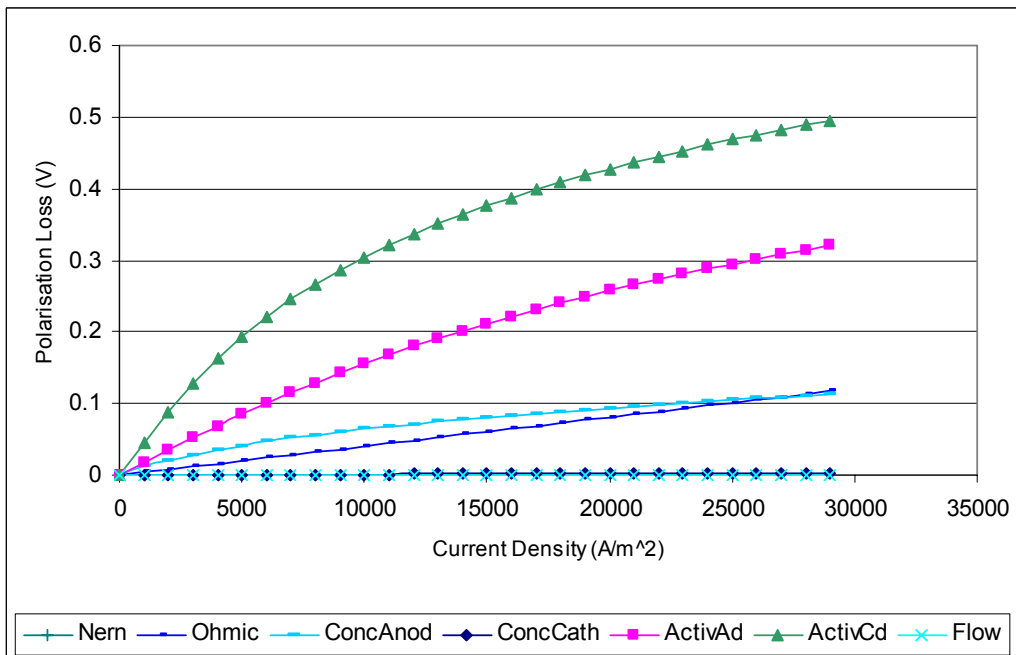


Figure 3. Source of Voltage Loss in Substrate Supported SOFC (1073K Fuel 97% H₂ after Chan 2001)

References:

- [1] S.H. Chan, K.A. Khor & Z.T Xia, A Complete Polarization Model of a Solid Oxide Fuel Cell and its Sensitivity to the Change of Cell Component Thickness, *Journal of Power Sources*, 93 (2001), pp 130-140.
- [2] J-W. Kim, A.V. Virkar, K-Z. Fung, K. Mehta, S.C. Singhal, Polarization effects in intermediate temperature, anode supported solid oxide fuel cells, *Journal of Electrochemical Society* 146 (1), pp69-78 (1999).

See also:

- [3] FACTS & FIGURES, an international Energy Association SOFC Task Report, Berne, April 1992.

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