SINGLE GAS ELECTRODES IN MOLTEN CARBONATES

Alina Borucka

Institute of Gas Technology
3424 South State Street
Chicago, Illinois 60616

ABSTRACT

The principles and the experimental requirements underlying accurate use of single gas electrodes as the reference electrodes in fuel cell studies are discussed in relation to typical geometric difficulties. In the case of the molten carbonate fuel cells, the most compatible gas electrodes for this purpose are the O_2/CO_2 and the CO/CO_2 electrodes supported by noble metals. The experimental study of these electrodes over the whole range of gas compositions and temperatures up to 800°C shows that their equilibrium potentials are determined respectively by the following overall reactions: $\frac{1}{2} O_2 + CO_2 + 2\bar{e} \rightleftarrows CO_3^{=}$ and $CO + CO_3^{=} \rightleftarrows 2CO_2 + 2\bar{e}$. Both these electrodes obey their respective Nernst equations accurately, but only the CO/CO_2 electrode provides a convenient standard potential scale based in $E_{CO/CO_2} = 0$ when $P_{CO} = P^2_{CO_2}$. The individual characteristics of these electrodes are presented graphically and discussed in relation to their practical limitations as well as their use as the reference electrodes in molten carbonate fuel cells. The results of an experimental correlation study between the O_2/CO_2 and the CO/CO_2 electrodes are compared with the thermodynamic predictions, and the potential of the O_2/CO_2 electrode is located on the standard CO/CO_2 potential scale for molten carbonate electrolytes.