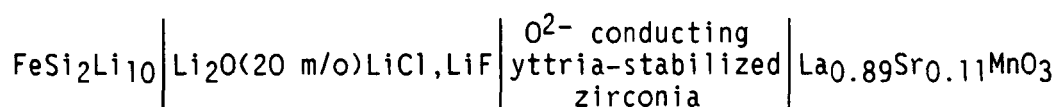


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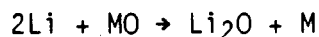
THE ELECTROCHEMICAL GENERATION OF USEFUL CHEMICAL SPECIES FROM LUNAR MATERIALS

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To be discussed here will be the current status of work in our laboratory on an electrochemical technology for the simultaneous generation of oxygen and lithium from a Li_2O containing molten salt ($\text{Li}_2\text{O}-\text{LiCl}-\text{LiF}$). The electrochemical cell utilizes an oxygen vacancy conducting solid electrolyte, yttria-stabilized zirconia, to effect separation between the oxygen evolving and lithium reduction half-cell reactions. The cell being studied possesses the general configuration:



The cell, which operates at 700–800°C, possesses rapid electrode kinetics at the lithium-alloy electrode with exchange current density (i_0) values being $>60 \text{ mA/cm}^2$, showing high reversibility for this reaction. When used in the electrolytic mode, lithium produced at the negative electrode would be continuously removed from the cell for later use (under lunar conditions) as an easily storable reducing agent (compared to H_2) for the chemical refining of lunar ores via the general reaction:



where MO represents a lunar ore. Emphasis to this time has been on the simulated lunar ore ilmenite (FeTiO_3), which we have found becomes chemically reduced by Li at 432°C. Furthermore, both Fe_2O_3 and TiO_2 have been reduced by Li to give the corresponding metal. The resulting Li_2O reaction product could then be removed from the solid-state reaction mixture by sublimation and reintroduced into the negative electrode compartment of the electrolytic cell. Hence, this electrochemical approach provides a convenient route for producing metals under lunar conditions and oxygen for the continuous maintenance of human habitats on the Moon's surface.

Because of the high reversibility of this electrochemical system, it has also formed the basis for the lithium-oxygen secondary battery. Prototype single cells are currently being fabricated and tested in our laboratory. This secondary lithium-oxygen battery system possesses the highest theoretical energy density yet investigated.

ACKNOWLEDGEMENTS

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