Solar Thermal Electrolytic Production of Mg from MgO

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The electrolytic production of Mg from MgO was experimentally and theoretically investigated near 1550 K. The oxide was dissolved in either CaF2 or MgF2. The cathode was Mo and the anode was either Pt or Cgr. Mg evolved as a gas, was quenched on cooling coils at the exit of the reactor and was collected for analysis. A thermodynamic cycle study indicates that the ideal thermal efficiency for the solar process is 35 percent for an inert anode and 39 percent for a carbon anode, making the process competitive with the industrial potential of other solar to metal processes. Experimental results from both current-cell potential traces and X-ray diffraction verify the successful electrolysis of MgO and the production of Mg. For all but one experiment, the experimental decomposition potential of the oxide was near the expected thermodynamic value. In one case where the electrolysis was done in MgF2 with a Pt anode, the decomposition potential was abnormally low, suggesting the possibility that the oxide decomposed through a chemical interaction with the fluoride. As expected, the experimental decomposition potential was reduced when carbon replaced the inert anode. In the experiment with Pt as the anode and MgF2 as the solvent, a current efficiency of 14 percent was measured. Further research should focus on methods to improve the current efficiency. Additionally, improved cell performance associated with a carbon anode suggests further methods to add biomass to the process should be investigated.

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