Thermal reduction of metal oxides with concentrated sunlight may provide viable paths to solar energy storage and/or renewable fuel production [1-3]. Various oxide materials and structures [4-7] have been proposed for use to temperatures >1000 °C depending on the oxide. The oxygen from the oxide under very rapid heating, typically in redox cycles with a high-temperature endothermic reduction step (on-sun). The reduction step releases in redox cycles with very rapid heating rates, which may induce non-equilibrium kinetics in the furnace temperature control to achieve reproducible cycle temperature profiles provides consistent high-temperature reduction as well as CO₂-based reoxidation at low-temperatures as measured by raman analysis of the effluent (O₂ and CO). Due to the very rapid CO₂ splitting reaction (Figure 1), integration of the peak areas for accurate measures of total degree of oxide reduction requires rapid gas composition analysis (1 second or less).

Well-characterized measurements in rapid heating furnace measurements are critical for assessing promising oxide materials like Ce₀.975Zr₀.025O₂ for concentrated solar reactor performance.

**References**


**Figure 1.** Metal oxide (Ce₀.975Zr₀.025O₂) fibers subjected to a thermal reduction in at 1500°C in an infrared furnace. The high temperature reduction step leads to O₂ release, and is followed by a re-oxidation at 800°C via exposure to CO₂. Heat rates are 100°C/min to minimize temperature overshoot and ensure sample temperature is accurately measured.