# A Rotary Receiver-Reactor for the Solar Thermal Dissociation of Zinc Oxide

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An improved engineering design of a solar chemical reactor for the thermal dissociation of ZnO at above 2000 K is presented. It features a rotating cavity-receiver lined with ZnO particles that are held by centrifugal force. With this arrangement, ZnO is directly exposed to concentrated solar radiation and serves simultaneously the functions of radiant absorber, chemical reactant, and thermal insulator. The multi-layer cavity is made of sintered ZnO tiles placed on top of a porous 80%$Al_2O_3$-20%$SiO_2$ insulation and reinforced by a 95%$Al_2O_3$-5%$Y_2O_3$ ceramic matrix composite, providing mechanical, chemical, and thermal stability and a diffusion barrier for product gases. 3D CFD was employed to determine the optimal flow configuration for an aerodynamic protection of the quartz window against condensable Zn(g). Experimentation was carried out at PSI's high flux solar simulator with a 10 kW reactor prototype subjected to mean radiative heat fluxes over the aperture exceeding 3000 suns (peak 5880 suns). The reactor was operated in a transient ablation mode with semi-batch feed cycles of ZnO particles, characterized by a rate of heat transfer – predominantly by radiation – to the layer of ZnO particles undergoing endothermic dissociation that proceeded faster than the rate of heat transfer – predominantly by conduction – through the cavity walls.