

Supporting Materials

Solid-State Redox Kinetics of CeO₂ in Two-Step Solar CH₄ Partial Oxidation and Thermochemical CO₂ Conversion

Mahesh Muraleedharan Nair and Stéphane Abanades *

Processes, Materials and Solar Energy Laboratory, PROMES-CNRS (UPR 8521), 7 Rue du Four Solaire, 66120 Font-Romeu Odeillo, France; mnair.mahesh@gmail.com

* Correspondence: Stephane.Abanades@promes.cnrs.fr; Tel.: +33-(0)4-68-30-77-30

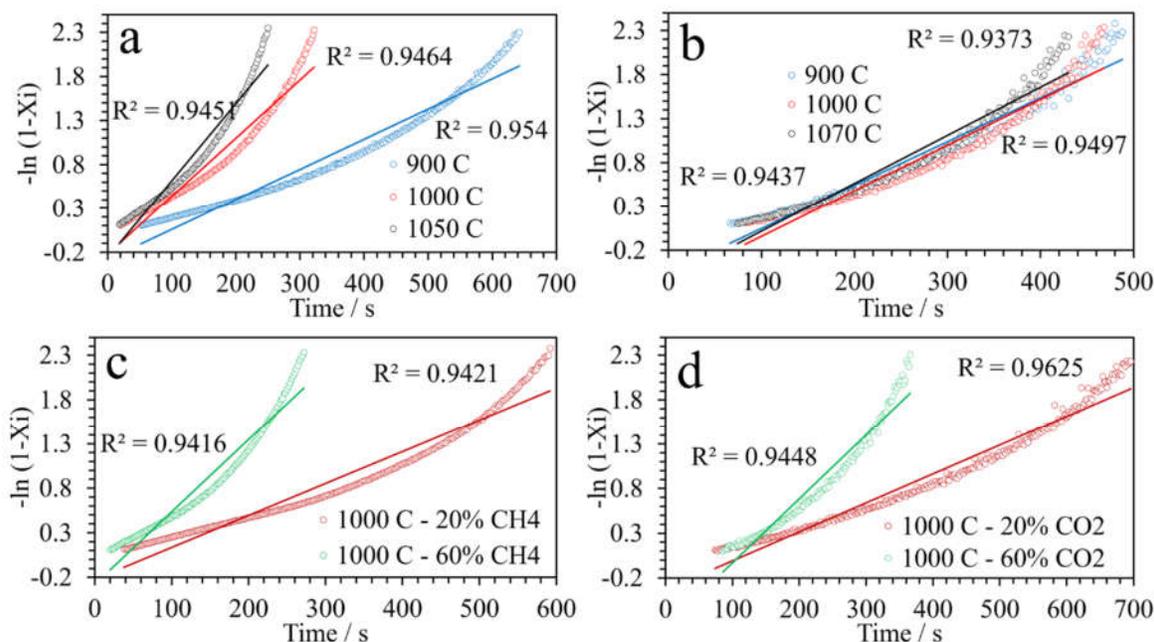


Figure S1. Comparison of experimental conversion data with first order model (F1) predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.

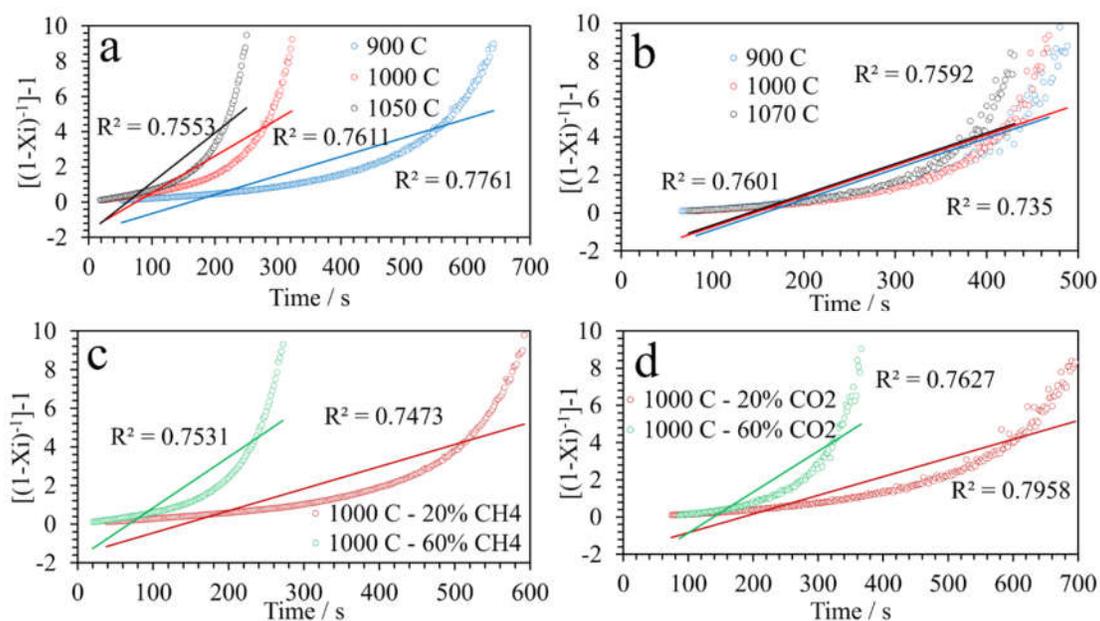


Figure S2. Comparison of experimental conversion data with power law model (PLM) predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.

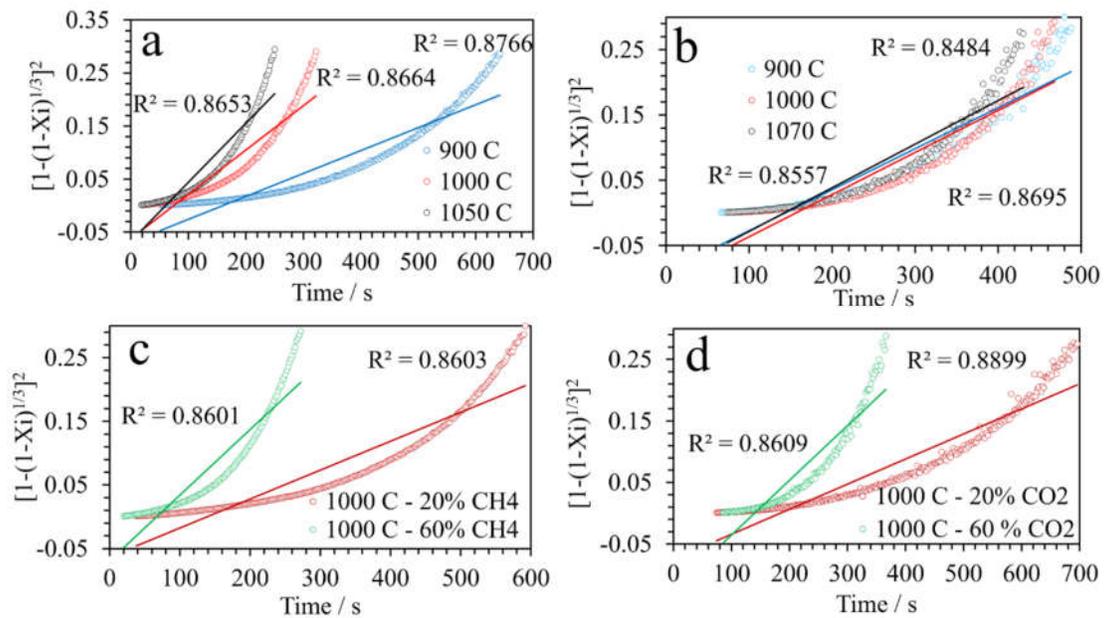


Figure S3. Comparison of experimental conversion data with 3D Janders diffusion (D3) model predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.

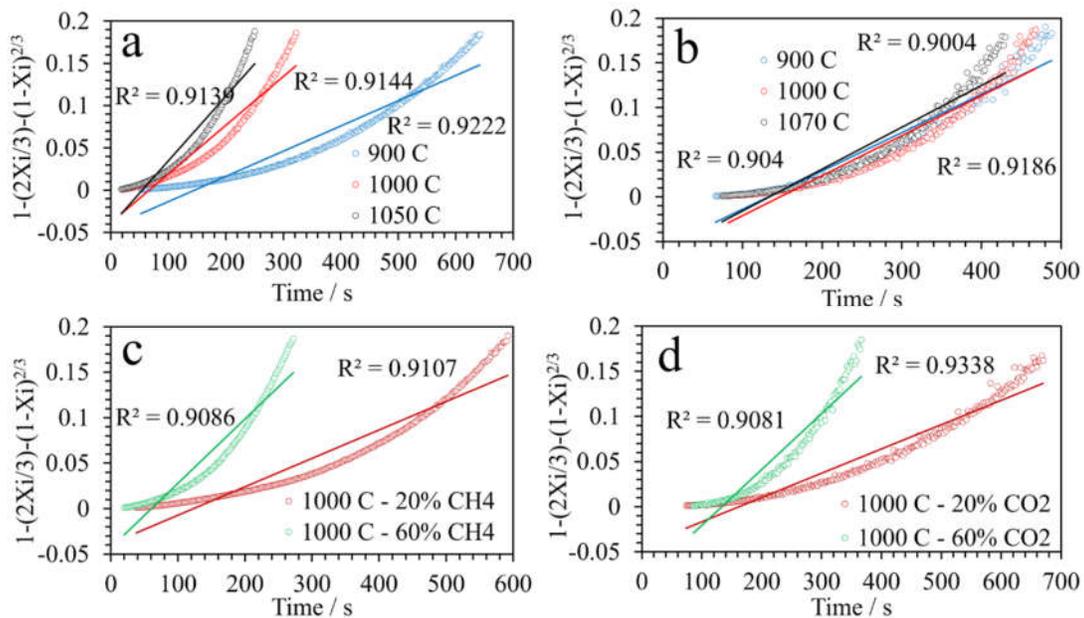


Figure S4. Comparison of experimental conversion data with 3D Ginstling diffusion (D4) model predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.

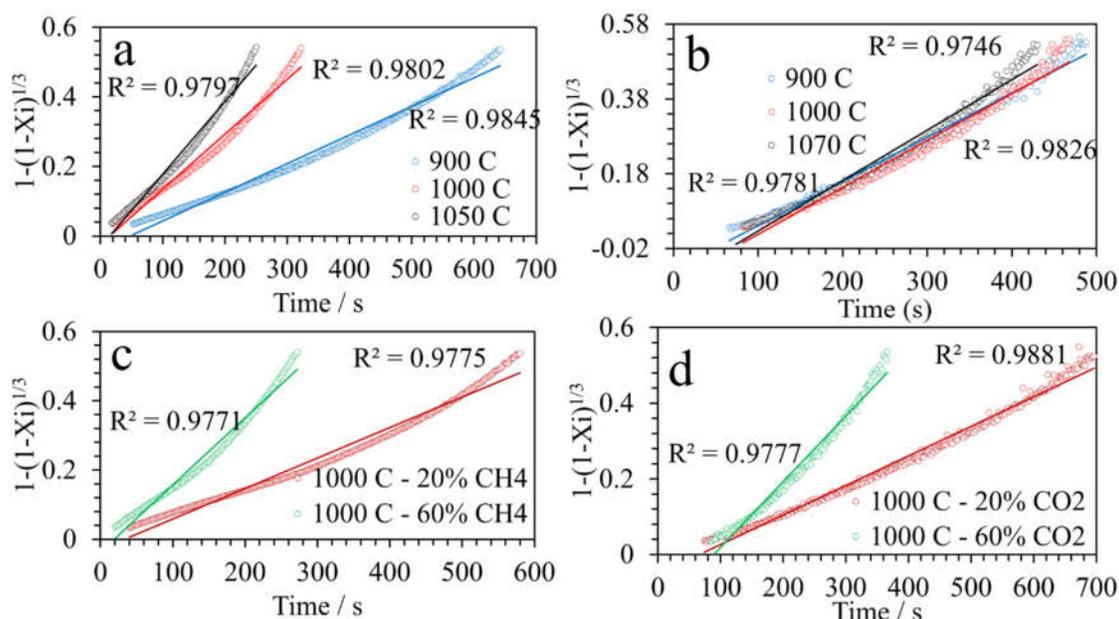


Figure S5. Comparison of experimental conversion data with 3D SCM (R3) predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.

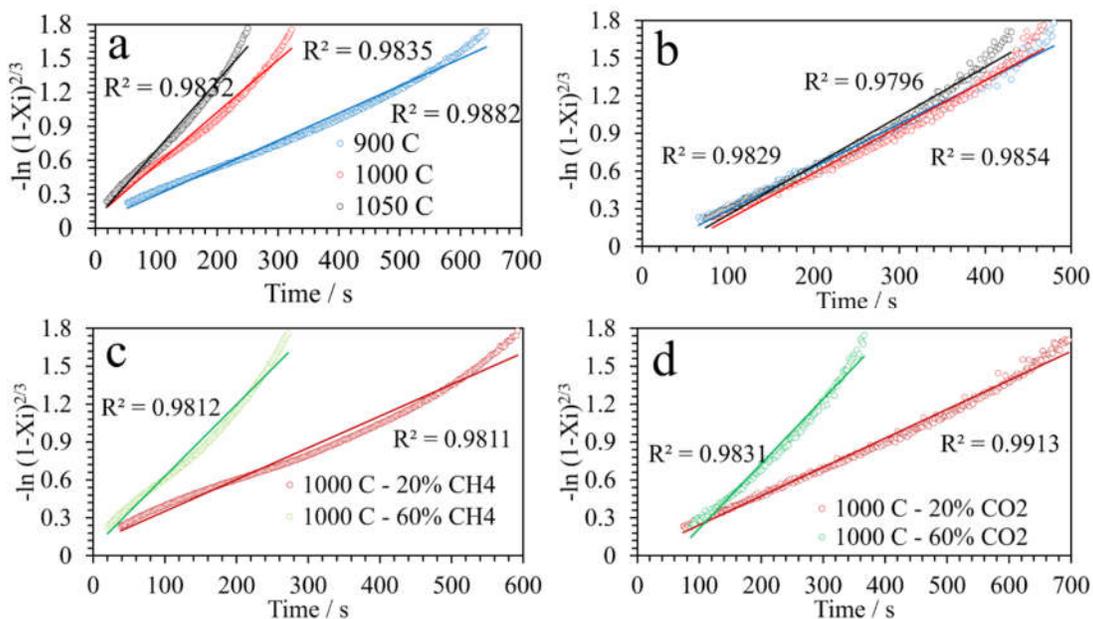


Figure S6. Comparison of experimental conversion data with 3D NGM (AE3) predictions for CeO₂ during (a) CH₄ induced reduction at selected temperatures, (b) CO₂ induced re-oxidation at selected temperatures, (c) varying CH₄ partial pressure during reduction, and (d) varying CO₂ partial pressure during re-oxidation. Partial pressure of the reactant gases was kept at 40% in (a) and (b). Experiments with varying partial pressures in (c) and (d) were carried out at 1000 °C.