SESSION: *Advanced Materials for energy conversion and storage*

Preference: ORAL presentation

Thermal energy storage reactor tests on Fe-doped $CaMnO_3$

E. Mastronardo[1,2], M. Sánchez[3], J. González[3], S.M. Haile[4], J.M. Coronado[1], L. Calabrese[2], E. Proverbio[2]

[1] Instituto de Catálisis y Petroleoquímica, CSIC, Madrid, Spain.
[2] Engineering Department, University of Messina, Messina, Italy
[3] Thermochemical Processes Unit, IMDEA Energy Institute, Madrid, Spain
[4] Materials Science and Engineering, Northwestern University, Evanston, IL, United States.

The design features of future Concentrating solar power (CSP) plants require high operating temperatures (≥800°C up to 1500 °C) [1]. This makes a compelling case for designing high-temperature (≥800°C) heat storage systems. Recently, $Ca(Fe_{0.1}M_{0.9})O_3$ has been investigated for high-temperature ThermoChemical heat storage (TCS) applications, and its thermodynamics previously measured through Van't Hoff approach via thermogravimetric analysis (TGA) by the authors [2]. We carry out here the evaluation of $Ca(Fe_{0.1}M_{0.9})O_{3-d}$ pellets heat storage performance through lab-scale reactor tests under reasonable operating conditions. The apparatus consists of a customized high-temperature furnace, an alumina reactor tube, a cooling system, and a MicroGas Chromatographer (mGC) that samples the O_2 concentration. In a typical experiment, the material is cycled between the selected reduction (T_r) and oxidation (T_o) temperatures. Several tests were carried out varying pO_2, T_r, and gas flow rate. The O_2 evolution while cycling was measured, and a comparison between 3-δ(T) profiles obtained by lab-scale reactor test (~50g) and TGA (~500mg) was carried out to verify the material's thermochemical performance at a significantly larger mass scale. Remarkably, it was evidenced that the material was able to exhibit the same performance than the one measured through TGA (Fig.1). Accordingly, CMF91 appears ideally suited for thermochemical heat storage applications with a large total heat storage capacity (~916 kJ/kg_{ABO3}) and good scalability.

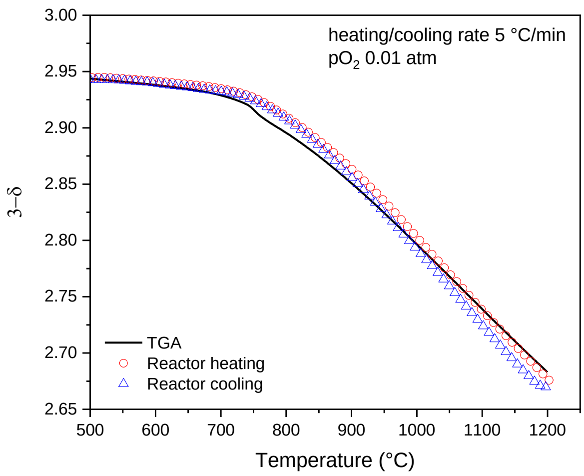

Fig.1 3-δ(T) profiles of CMF91 material measured by reactor test and TGA.

[1] *L.A. Weinstein et al. Chem. Rev., 2015, 115, 12797*
[2] *E. Mastronardo et al. J. Mater. Chem. A, 2020, 8, 8503*

Corresponding Author e-mail: emastronardo@unime.it
*lead presenter: emastronardo@unime.it