**DOI background**

The data for this paper has been divided into four folders, one for each individual figure. The data is therefore divided into identified by the figure number from the corresponding paper.

Figure 1 of the paper was of temperature programed reductions of YBaCo4O7 using a thermogravimetric analyser and corresponding X-ray diffraction (XRD) and EDX profiles before and after the scans. This data for Figure 1 can be found in the folder named Figure 1, and is split into three sections, thermogravimetric (TG), XRD and EDX results. The individual folders for the XRD and TG data contains subsections for each gas used (5 mol% CO, 50 mol% CO2 and 5 mol% H2). An additional subsection is present in the XRD results showing the phase before the gas treatments. EDX analysis was only performed on a sample after CO treatment, and as such is not labelled.

Figure 2 of the paper showed stepwise heating of the material after being brought to a controlled stoichiometry. The TG data for Figure 2 is stored in the file labelled Figure 2. The file contacting the data presented for the data shown for pO2’s of 0.05, 0.1, 0.21 and 0.42 bar can be found in the file named *1147-quasi-eq-exp*. Data for pO2 of 0.31 bar can be found in the file titled “*30%\_repeat”*.

Figure 3 of the paper showed isothermal oxygen incorporation and release cycles of the material, cycling between air and helium. The TG data for Figure 3 can be found in the folder labelled Figure 3. The file containing the data shown can be found in “*Oxyfuel-cycles”* and “*Oxy-fuel-h-t- cycles” (note; this file only contains the 330°C cycles shown in the work.)*.

Figure 4 of the paper showed cycling of the material between air and a higher pO2 to demonstrate the use of the material for oxygen enrichment. The TG data for Figure 4 can be found in the folder labelled figure 4. The file containing the data is labelled “*1147-oxy-cyc”.*

The majority of this work involves TG data, and this data is easiest read by importing the excel document in each individual folder into an open excel tab and separating by space. The weight of the sample can be seen by the tab “SampleWeightCurrent (g)”, the time stamp can be found in the tab labelled, “Time (min)” and the temperature by the tab labelled, “Temperature(°C)”. Other temperatures labelled in the file are not the sample temperature and correspond to other parts of the machine to ensure no vapour deposition within the unit, and as such are unrelated to these experiments. A user should be aware that for the first few minutes of a segment change, the TGA is programmed to stop the gas flow before restarting, creating a noise in the signal. The gases a user will see flow are labelled by valve position, the different gasses from each position are as follows:

**Table 1** – Different gases used through each valve number during these experiments.

|  |  |
| --- | --- |
| **Gas number** | **Composition** |
| **1** | He |
| **2** | Ar |
| **3** | 5% O2 |
| 5%H2 |
| 5%CO |
| **4** | Synthetic air |

To obtain the different pO2’s investigated during the experiments, different total pressures of the oxygen containing gases were used. It should be noted that the pressure labelled in the files has an offset of 0.2 bar, meaning a labelled pressure of 0.8 bar is actually equal to 1 bar. Table 2 shows the pressures and gas composition used to form each pO2.

**Table 2** – Different methods of obtaining the pO2’s used during the experiments

|  |  |
| --- | --- |
| **pO2 (bar)** | **Method** |
| 0.05 | 1 bar 5% O2 |
| 0.1 | 2 bar 5%o2 |
| 0.21 | 1 bar synthetic air |
| 0.31 | 1.5 bar synthetic air |
| 0.42 | 2 bar synthetic air |