ESRF	**Experiment title:** High-Temperature Mobility of Ce^{4+} ions in Yttrium Stabilized Zirconia Ceramics	**Experiment number**: 20-01-825
Beamline: BM20 ROBL	**Date of experiment**: from: 13/07/2021 to: 19/07/2021	**Date of report**: 13/09/2021
Shifts: 18	**Local contact(s)**: C. Hennig	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*SVITLYK Volodymyr, BM20 HZDR ROBL
*HENNIG Christoph, BM20 HZDR ROBL

Report:

During the 20-01-825 experiment ten samples in the Ce-doped Yttrium Stabilized Zirconia (YSZ) system were studied *in situ* as a function of external temperature. Specifically, powder diffraction patterns the tetragonal ($Ce_{0.000}Y_{0.140}Zr_{0.860}O_{2-x}$, $Ce_{0.030}Y_{0.136}Zr_{0.834}O_{2-x}$, $Ce_{0.060}Y_{0.132}Zr_{0.808}O_{2-x}$, $Ce_{0.090}Y_{0.127}Zr_{0.783}O_{2-x}$, $Ce_{0.120}Y_{0.123}Zr_{0.757}O_{2-x}$) and cubic ($Ce_{0.000}Y_{0.250}Zr_{0.750}O_{2-x}$, $Ce_{0.030}Y_{0.243}Zr_{0.728}O_{2-x}$, $Ce_{0.060}Y_{0.235}Zr_{0.705}O_{2-x}$, $Ce_{0.090}Y_{0.228}Zr_{0.683}O_{2-x}$, $Ce_{0.120}Y_{0.220}Zr_{0.660}O_{2-x}$) Ce-YSZ samples were collected in a *RT* – 1150 K – *RT* temperature range. Both Ce-YSZ families have been found to be structurally stable at high temperatures (Fig.1) and no discharge of Ce^{4+} ions was observed (Fig. 2, $Ce_{0.060}Y_{0.132}Zr_{0.808}O_{2-x}$ is shown as an example on both figures).

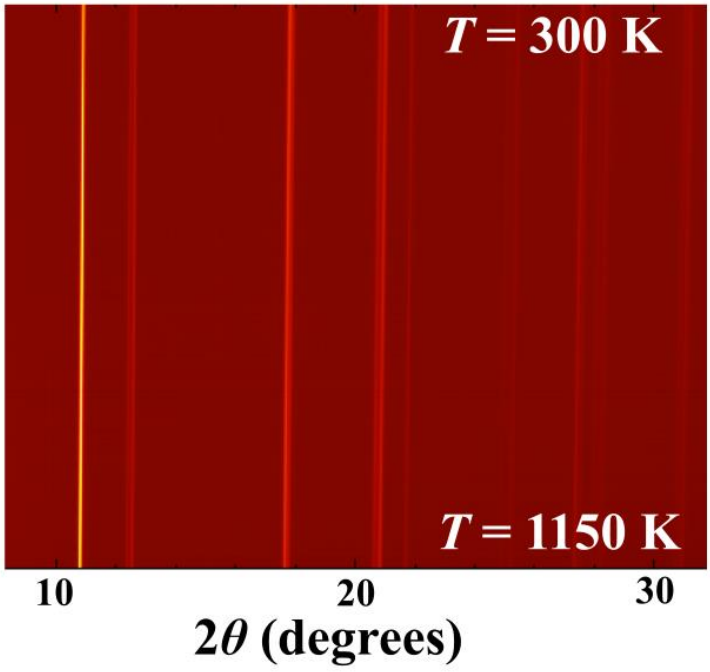

Fig. 1. Evolution of diffraction pattern of tetragonal $Ce_{0.060}Y_{0.132}Zr_{0.808}O_{2-x}$ upon heating indicating absence of any structural transformations

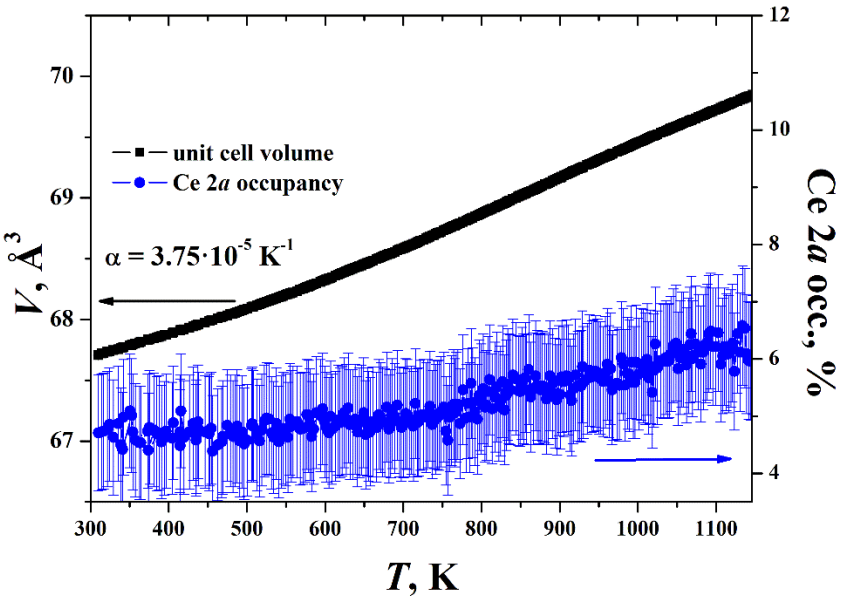

Fig. 2. Evolution of cccupancy of Ce^{4+} (blue) and unit cell volume (black) of $Ce_{0.060}Y_{0.132}Zr_{0.808}O_{2-x}$ upon heating

These results are promising in a context of nuclear waste storage. In these phases Ce^{4+} species have been used as surrogate ions for tetravalent actinide elements like U, Th or Pu. Therefore, incorporated actinide elements in analogous YSZ phases are expected feature similar *T*-dependent behavior, i.e. strong affinity with the parent YSZ matrices. In addition, linear coefficients of thermal expansion have been obtained for all the samples. A corresponding scientific article is currently being written and will be submitted in 2021. Following this successful experiment further experiments as a function of external pressure are planned on these phases.