ESRF	**Experiment title: Valance changes in High Entropy Transition Metal Oxides based on ($Co_{0.2}Cu_{0.2}Mg_{0.2}Ni_{0.2}Zn_{0.2}$)O: High Temperature XANES**	**Experiment number**: HC-4191
Beamline: BM23	**Date of experiment**: from: 04.02.2021 to: 09.02.2012	**Date of report**: 22.02.2021
Shifts: 21	**Local contact(s)**: Angelika Rosa	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Richard Brand, INT Karlsruhe Institute of Technology

***Benedikt Eggert, Universität Duisburg-Essen Experimentalphysik**

***Abhishek Sarkar, Darmstadt Institute of Materials Science**

Robert Kruk, Karlsruhe Institute of Technology

***Johanna Lill, Universität Duisburg-Essen Experimentalphysik**

Heiko Wende, Universität Duisburg-Essen Experimentalphysik

Report:

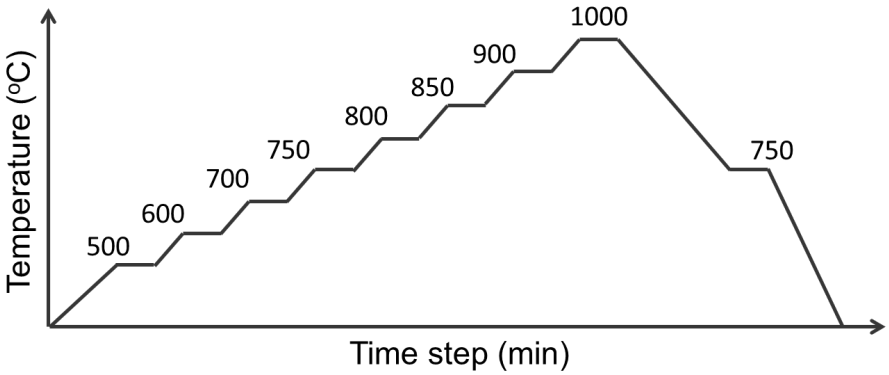
This was our first experiment via remote control. Despite this, the experiment ran smoothly due to the excellent on-site support.

Our aim was to study valance changes at high temperature, which along with the high configurational entropy, contribute to the lattice stability of these systems. The temperature range studied was 700 - 10000 C in vacuum. We focused on the Co/Cu/Ni K-edges, comparing several different equiatomic compositions.: (A) (Co,Cu,Mg,Ni,Zn)O, (B) (Co,Mg,Ni,Zn)O and (C) (Co,Cu,Mg,Ni)O.

Experiments in Vacuum: Our findings show that contrary to all expectations (vapor pressure of the constituant oxides at high temperature), there was a clear trend to metallic behavior with increasing temperature and this metallic signature remained on a return to room temperature. This reducing effect at high temperatures is new and will necessitate further studies.

However this metallic trend differs for the different elements. Below is the heating cycle used, starting and ending at room temperature.

On the middle figure we show Sample ($Co_{0.25}Mg_{0.25}Ni_{0.25}Zn_{0.25}$)O with metallic references for the Co, Ni and Zn edges. The Zn signal does not metallise but there is an obvious structural transition. In the lower figure we show the Ni edge in NiO. Surprisingly there is no trend to metallic behaviour.



$(Co_{0.25}Mg_{0.25}Ni_{0.25}Zn_{0.25})O$: All edges

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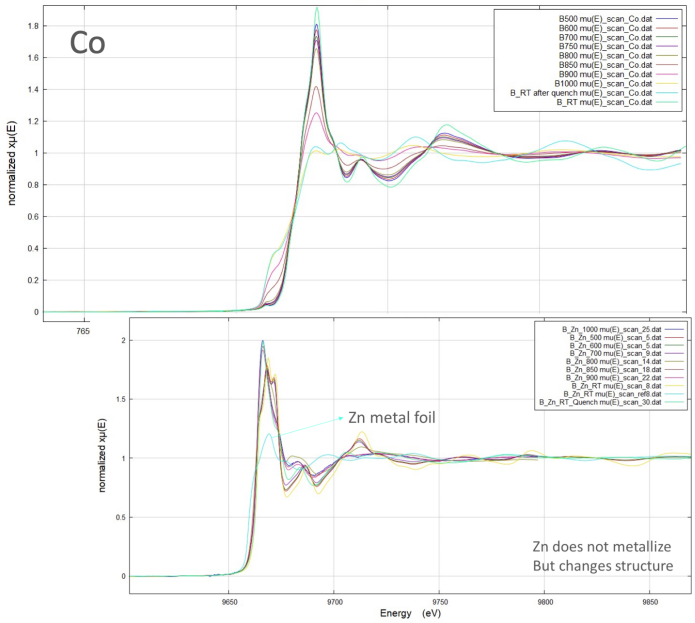

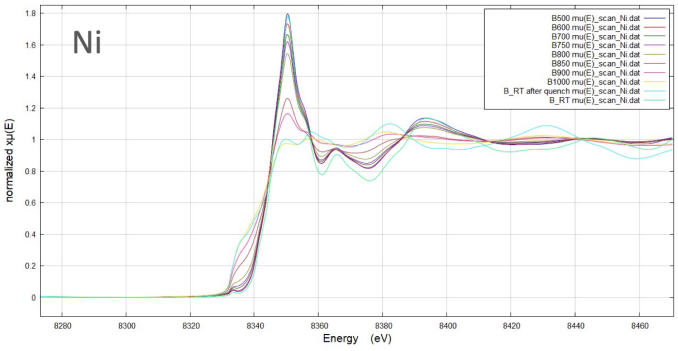

- Co, Cu and Ni metallize
- Zn does not metallizes
- Structural change in Zn