

## Redox reactions followed by RIXS

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Material scientists are constantly looking for techniques to better characterize their samples and are turning more and more to RIXS-related spectroscopies. Of particular interest is to monitor changes during chemical reactions. Transition metal ions take part in chemical reactions by modifying their ligand environment and/or by changing their oxidation states. Such changes can manifest themselves in various ways in the spectra: Screening effects will modify the energy levels and result in a shift of the absorption edge. Electron-electron interactions give rise to multiplet effects that manifest themselves in rich spectral features. Finally, changes of the local atomic environment that often accompany changes of oxidation states may result in edge shifts and modifications of the spectral intensities. Interpretation of the spectra remains an enormous challenge despite considerable improvement in theoretical modeling. An additional complication arises from the heterogeneity of the sample where the absorber element occurs in different chemical environments. The challenge for the spectroscopist is to extract information from the spectra despite the complexity. This is almost always done by using model systems or qualitative arguments and only in few cases supported by calculations of the electronic structures. The presentation will give some examples for the application of RIXS in the characterization of nanoparticles and active sites in catalysis.

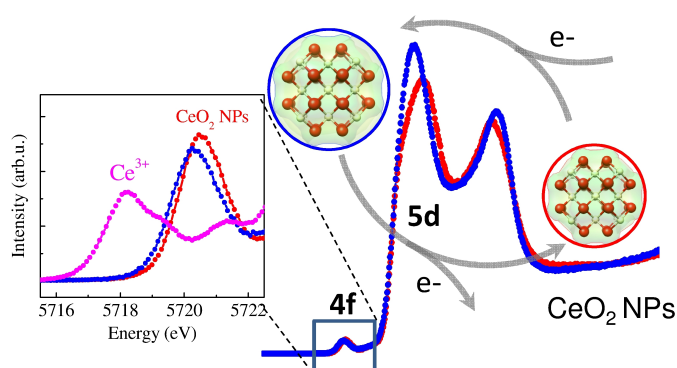


Figure 1: Spectral changes at the Ce L<sub>3</sub>-edge measured for 3nm CeO<sub>2</sub> nanoparticles when interacting with H<sub>2</sub>O<sub>2</sub>.

### References

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- [3] Cafun, J.-D., Kvashnina, K. O., Casals, E., Puentes, V. F. & Glatzel, P. Absence of Ce<sup>3+</sup> sites in chemically active colloidal ceria nanoparticles. *ACS Nano* **7**, 10726 – 10732 (2013).

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