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Combining x-ray emission and x-ray Raman spectroscopy for the study of Earth materials at high pressure and high temperature

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X-ray emission and x-ray Raman scattering spectroscopy are powerful tools to investigate the local electronic and atomic structure of high and low Z elements in situ and can be applied at high pressure and high temperature conditions which are present in e.g. the Earth's mantle. We developed a setup for simultaneous x-ray emission (Fe $K\beta_{1,3}$ and valence to core) and x-ray Raman scattering (low Z elements' absorption edges) studies at beamline P01 of PETRA III synchrotron radiation source using a wavelength dispersive von Hamos spectrometer together with the existing multiple-analyzer Johann-type spectrometer in combination with a laser heating device. It's capabilities are demonstrated by investigating the iron spin crossover in siderite ($FeCO_3$) and bridgmanite ($(Mg,Fe)SiO_3$). This setup provides a unique combination in order to achieve new insights into the spin transition and compression mechanisms of mantle materials which is of importance for the understanding of the macroscopic physical and chemical properties of the inner Earth.

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