High Temperature Furnace Designs for *in situ* X – Ray Absorption Spectroscopy under Reactive Gas Flow Conditions

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A high temperature induction furnace has been designed and constructed for *in situ* X-ray spectroscopic experiments under controlled atmospheric conditions at temperatures up to 3000°C. The multi-purpose chamber design allows working in forward backscattering, normal fluorescence and transmission mode for synchrotron X-ray absorption and emission spectroscopy. On ID26 the use of the furnace has been demonstrated in a study of the oxidation state of chromium in oxides using X-ray Absorption Near Edge Spectroscopy (XANES). Fluorescence-yield XANES spectra at the Cr *K*-edge were collected between 1550 and 1750°C at log$P$O$_2$s between -10 and -11.3 imposed by CO/CO$_2$ gas mixtures. A multi-wavelength pyrometer was used as a non-contact temperature probe. The setup is of particular interest to study liquid metals, alloys and other electrically conductive materials at extreme conditions.

Furthermore, a new gas-flow reactor cell has been developed to work in fluorescence mode for *in situ* and dynamic X-ray absorption experiments on chemical systems. The compact design of the cell and the versatility of the different components of the set-up (reactor cell and cooled silicon diode) permit fine-tuning the system so that the optimal geometrical conditions can be attained. This set-up has been used on ID24 (the energy dispersive beamline for X-ray Absorption Spectroscopy at the ESRF) to perform time resolved studies on low-loaded heterogeneous catalysts under catalytic gas-flow conditions (O_2/H_2 cycles), reaching temperatures up to 850°C with an accuracy of +/-5°C. This unique experiment has opened new horizons for car manufacturers on the development of novel catalytic exhaust converters.