VerSoX B07-B: A High-Throughput XPS and Ambient Pressure NEXAFS Beamline for Surface and Interface Studies of Gases, Liquids and Solids

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We present a new beamline for soft X-ray spectroscopy at Diamond Light Source, VerSoX B07-B. B07-B delivers medium flux X-rays in the range 45-2200 eV, covering the K edges of Lithium to Phosphorus and the $L_{2,3}$ edges of the first row transition metals. It has dedicated endstations for high-throughput X-ray Photoelectron Spectroscopy (XPS) under ultrahigh vacuum conditions, and Near-Edge X-ray Absorption Fine Spectroscopy (NEXAFS) under ambient conditions, respectively. B07-B enables studies of a wide range of surfaces and gas-solid interfaces over many decades of pressure range, as well as liquids using a custom-built in-situ electrochemical cell. We will present the beamline and endstation designs and discuss their performance and the commissioning process, as well as opportunities for future developments and advancements. We also present some first results from a prototype microreactor for soft XAS measurements at elevated pressure and temperature (tested up to 0.9 bar and 400 °C) using the Total Electron Yield detection mode to probe the first few nanometres of a sample. We use the Fischer-Tropsch (FT) reaction as our test case as the combination of high temperature and pressures of toxic, flammable gases, the undoubted mechanistic complexity and a product slate comprising both gases and liquids makes this an ambitious and relevant study.

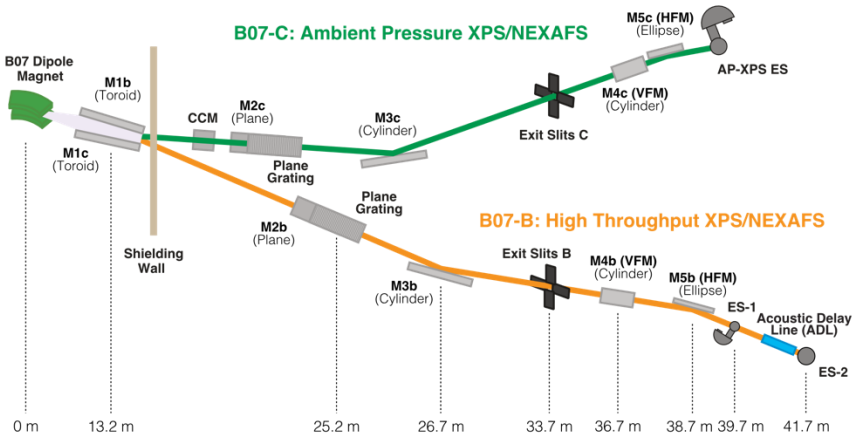

Figure 1. Schematic layout of the VerSox B07 beamlines, showing the separate branches for AP-XPS (B07-C) and high-throughput XPS and ambient pressure NEXAFS (B07-B). Reproduced from Grinter et al. Synchrotron Radiation News, 35, 2022.

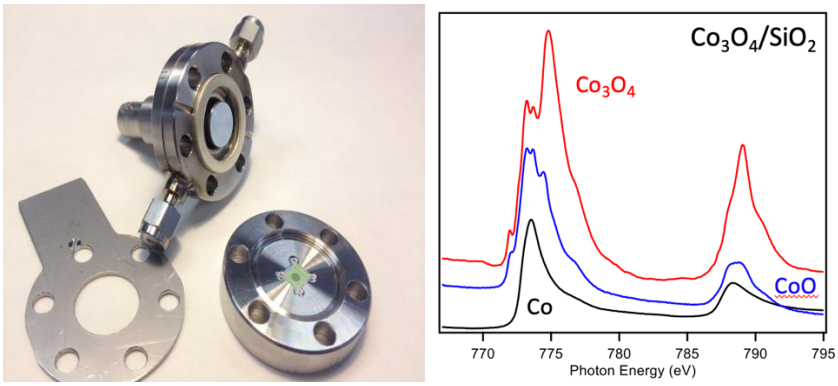

Figure 2. Photograph of the prototype microreactor and Co L edge NEXAFS showing the in-situ reduction of Co_3O_4 nanoparticles acquired at 0.9 bar H_2 at 350 C.