

	<b>Experiment title:</b> Evolution of magnetic moments in SmCo <sub>5</sub> during in situ hydrogen charging/discharging	<b>Experiment number:</b> <b>MA-5664</b>
<b>Beamline:</b> ID12	<b>Date of experiment:</b> from: July 18, 2023                      to: July 25, 2023	<b>Date of report:</b> Oct. 13, 2023
<b>Shifts:</b>	<b>Local contact(s):</b> Andrei Rogalev Elvina Dilmieva	<i>Received at ESRF:</i>
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**Report:**

We found that by applying the voltages of only 1 V, the coercivity and magnetocrystalline anisotropy of micrometer-sized SmCo<sub>5</sub> and Sm<sub>2</sub>Co<sub>17</sub>-based magnets can be reversibly modulated by the magnitude of ~1 T. Moreover, the voltage-assisted magnetization reversal have firstly been achieved at room temperature. This has aroused great interests in the field of magnetism and spintronics. However, the mechanism behind the process, e.g. how hydrogen atoms interact with neighboring Sm and Co atoms and the local magnetic moments change remain to be discovered. Thus, we proposed to use X-ray magnetic circular dichroism (XMCD) to study the evolution of atomic magnetic moments in at L<sub>2,3</sub>-edges of Sm and K-edge of Co during hydrogen insertion. For that, we designed the miniaturized electrochemical cells that can be integrated with high-field XMCD setup at ID12 for in situ observation. The schematic drawing of the miniaturized cell and a photo of the manufactured cell are shown below Figure 1 and Figure 2, respectively.

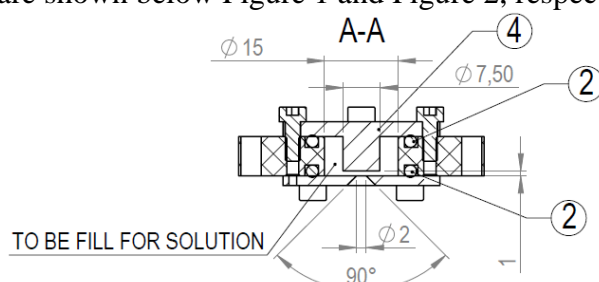


Figure 1 Schematic drawing of the miniaturized electrochemical cell

Following the design, the mechanical workshop has successfully manufactured the cell, the photo of which is shown below.

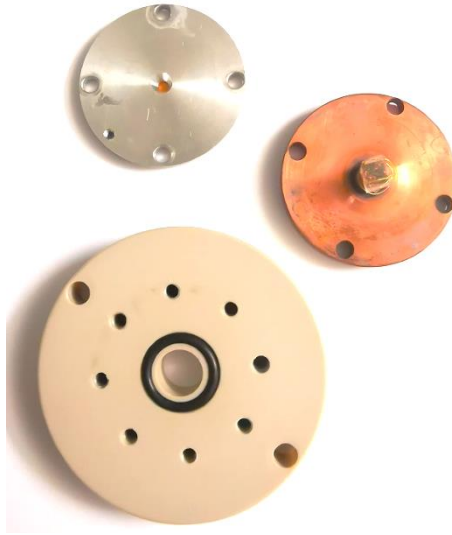


Figure 1 A photo of the manufactured miniaturized electrochemical cell used in in-situ XMCD experiments

Using this setup, we have then performed XMCD measurements during the application of external voltages under control of Keithley powersource. The measurements were performed sequentially. Firstly, we measured the pristine SmCo5 powder sample. Secondly, we measured the pristine sample with the electrolyte of diluted KOH electrolyte with a thickness of about 0.8 mm. Compared with the K-edge signals obtained with the bare pristine sample, those obtained with electrolyte have been significantly reduced. Thus, we further optimized the electrochemical setup to reduce the thickness of the encapsulated electrolyte by which the good signal were acquired. Thirdly, we further applied the external voltage to induce the absorption of hydrogen atoms into the material and simultaneously measured the samples. However, here another problem occurred. The very thin electrolyte seems to impede the hydrogen absorption process. Therefore, lots of efforts have been devoted to furthe optimize the electrochemical setup to ensure both the good signal-to-noise ration and the effective absorption of hydrogen atoms.

Part of the preliminary data from the pristine sample and those during the hdyrogen charging process are shown below. We are still in the process of analyzing the data for publication.

