



**Extended Data Figure 5 | A schematic of the experimental setup for *in situ* XRR measurement at the Advanced Photon Source.** The SNO thin film was connected to a working electrode and submerged in a 0.01 M KOH aqueous solution. A Kapton film was used to avoid the spillage

of electrolyte during measurement. The electric potential was applied through the counter-electrode. After the treatment, the XRR signals were collected *in situ*.