

## Supporting information

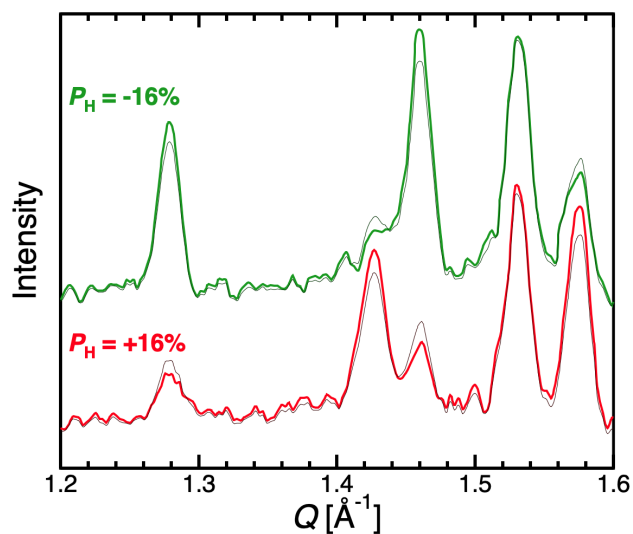


Fig. 1. Comparison of  $I_{\text{obs}}^{\pm}(Q, P_{\text{H}})$  (thin) and  $I(Q, P_{\text{H}})$  (thick) at the  $Q$ -range where neutrons with  $\lambda \leq 2.0 \text{ \AA}$  ( $p_{\text{n}}(\lambda) \leq 80\%$ ) were measured. Note that the differences between  $I_{\text{obs}}(Q, P_{\text{H}})$  and  $I(Q, P_{\text{H}})$  are negligibly small at the other  $Q$ -range where neutrons with  $p_{\text{n}}(\lambda) \approx 100\%$  were measured.

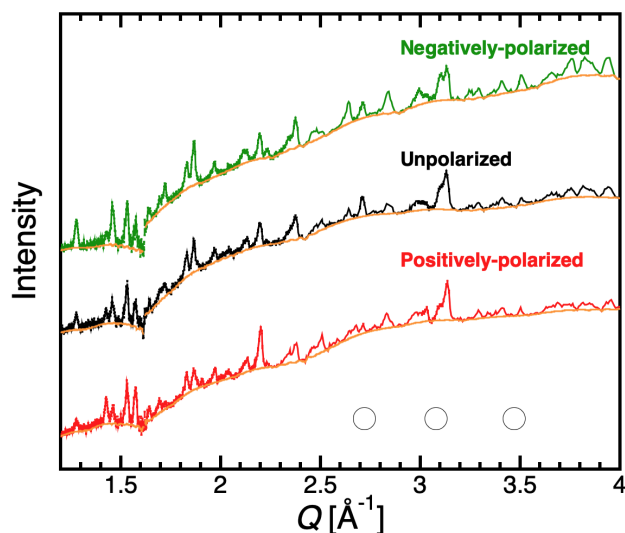


Fig. 2. Intensities at different  $P_{\text{H}}$ s for the LGA sample before subtracting of the broad scattering and the neutron polarization correction.  $\circ$  indicates the  $Q$  values of diffraction peaks of aluminum in the neutron windows. The orange curves are estimated broad scattering excluding the diffraction peaks of the LGA and aluminum.