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Design and technical commissioning of the In Situ Nanoprobe endstation and instrument at the Advanced Photon Source

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The In Situ Nanoprobe (ISN) is a newly constructed, best-in-class experimental instrument at sector 19 of the upgraded Advanced Photon Source (APS-U). The new ISN beamline provides a 5-30 keV monochromatic x-ray beam, high coherence, and focused flux of $>3 \times 10^{11}$ photon/sec @ 25 keV. KB mirror focusing offers a focal spot as low as 20 nm. The KB mirrors also provide a long working distance of 61 mm, to enable a versatile suite of sample environments: in-vacuum or in-air operation, heating to $>1000^\circ\text{C}$, cooling to 40K, flow of liquids & gases, and applied electrical fields. The instrument supports fast fly-scanning of relatively large and heavy samples of $\sim 10 \times 10 \text{ mm}$ and 2kg at 1mm/s. Measurement techniques include 2D and 3D XRF mapping, ptychographic coherent structural imaging, x-ray diffraction, and x-ray excited optical luminescence. This work presents the first mechanical results from the ongoing technical commissioning in Summer 2025, including the design and architecture of the endstation, vibrational and thermal management, beam conditioning optics, KB mirror alignment, vacuum chamber design, sample scanning, sample environments, metrology, and detector systems design.

Footnotes

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