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Supplementary Materials for

Superconductivity across Lifshitz transition and anomalous insulating state in surface K–dosed ($Li_{0.8}Fe_{0.2}OH$)FeSe

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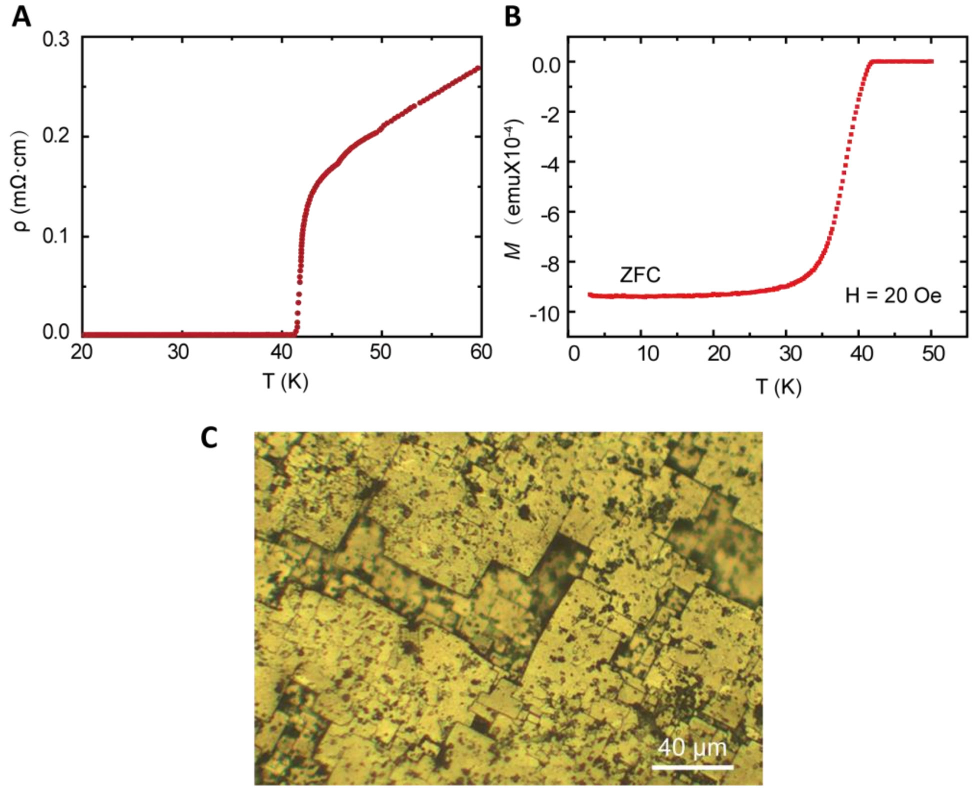

fig. S1. Resistivity, dc magnetic susceptibility measurement, and optical microscopy image of $(Li_{0.8}Fe_{0.2})OHFeSe$ single crystal. (**A**) Temperature dependence of the resistivity of $(Li_{0.8}Fe_{0.2})OHFeSe$ single crystal. (**B**) Temperature dependence of the DC magnetic susceptibility of $(Li_{0.8}Fe_{0.2})OHFeSe$ measured with zero-field cooling (ZFC). (**C**) Optical microscopy image of a surface of $(Li_{0.8}Fe_{0.2})OHFeSe$ single crystal.

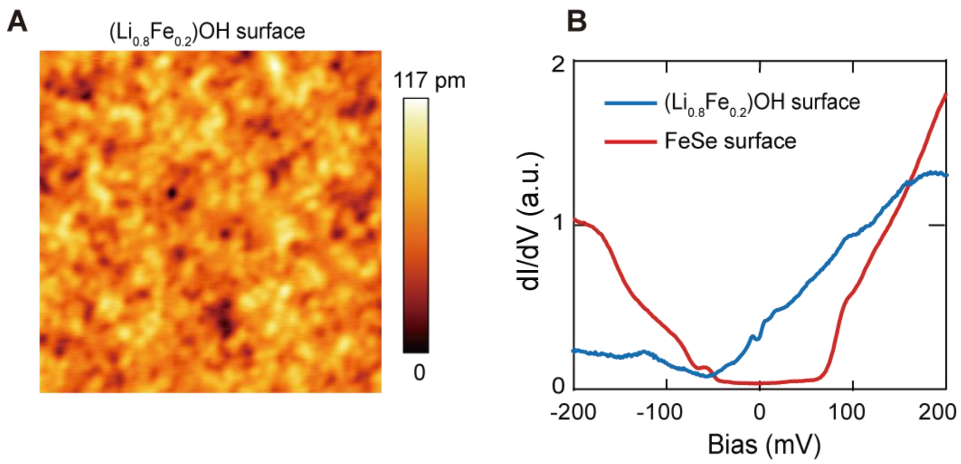

fig. S2. Topographic image and STS taken on the as-cleaved $Li_{0.8}Fe_{0.2}OH$ surface. (**A**) Topographic image of as-cleaved $Li_{0.8}Fe_{0.2}OH$ surface. (**B**) dI/dV spectra taken on $Li_{0.8}Fe_{0.2}OH$ surface and FeSe surface, respectively.

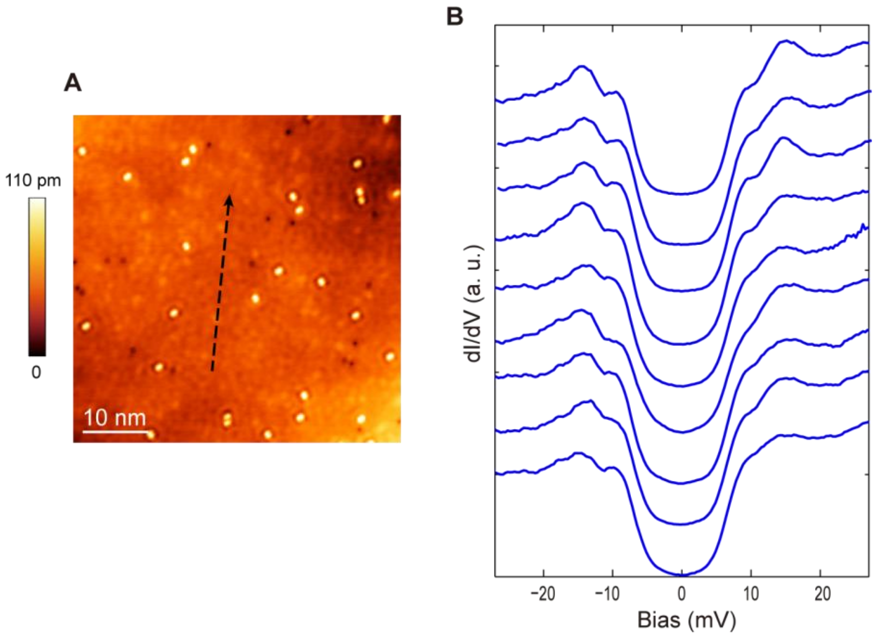

fig. S3. Spatial distribution of the superconducting gap on the as-cleaved FeSe surface. (**A**) Topography of FeSe surface (same as Fig. 1A). (**B**) dI/dV spectra taken along the line cut marked in (A) shows a spatially-homogenous superconducting gap.

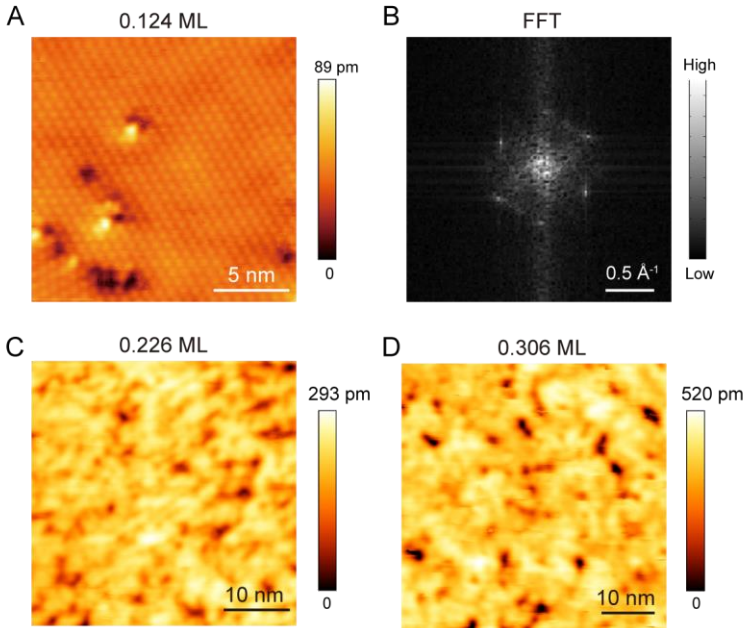

fig. S4. Additional topographic images of the FeSe surface after K dosing. (**A**). K_c=0.124 ML, taken mostly in a single rotational domain. (**B**) FFT image of (A), showing six Bragg spots. (Note that due to the tip drift in scanning the Bragg spots are not perfectly six-folding symmetric). (**C**) K_c=0.226 ML (size: 40×40 nm^2), (**D**) K_c=0.306 ML (size: 50×50 nm^2)

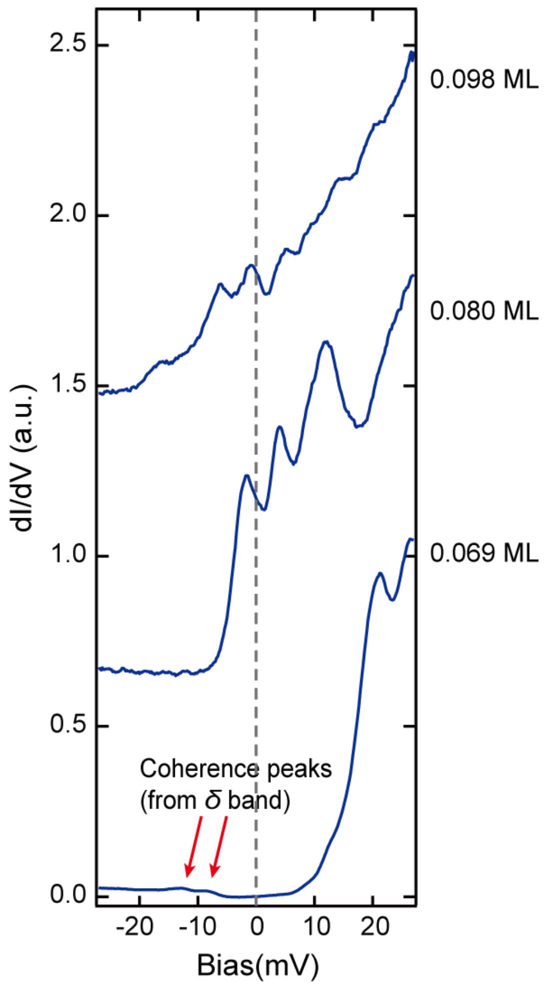

fig. S5. Unnormalized d*I*/d*V* spectra at the K_c near Lifshitz transition.

Un-normalized dI/dV spectra of K_c=0.069 ML, 0.080ML and 0.098 ML, showing the evolution of the DOS near the Lifshitz transition. The red arrows indicate the double coherence peaks of the δ band.

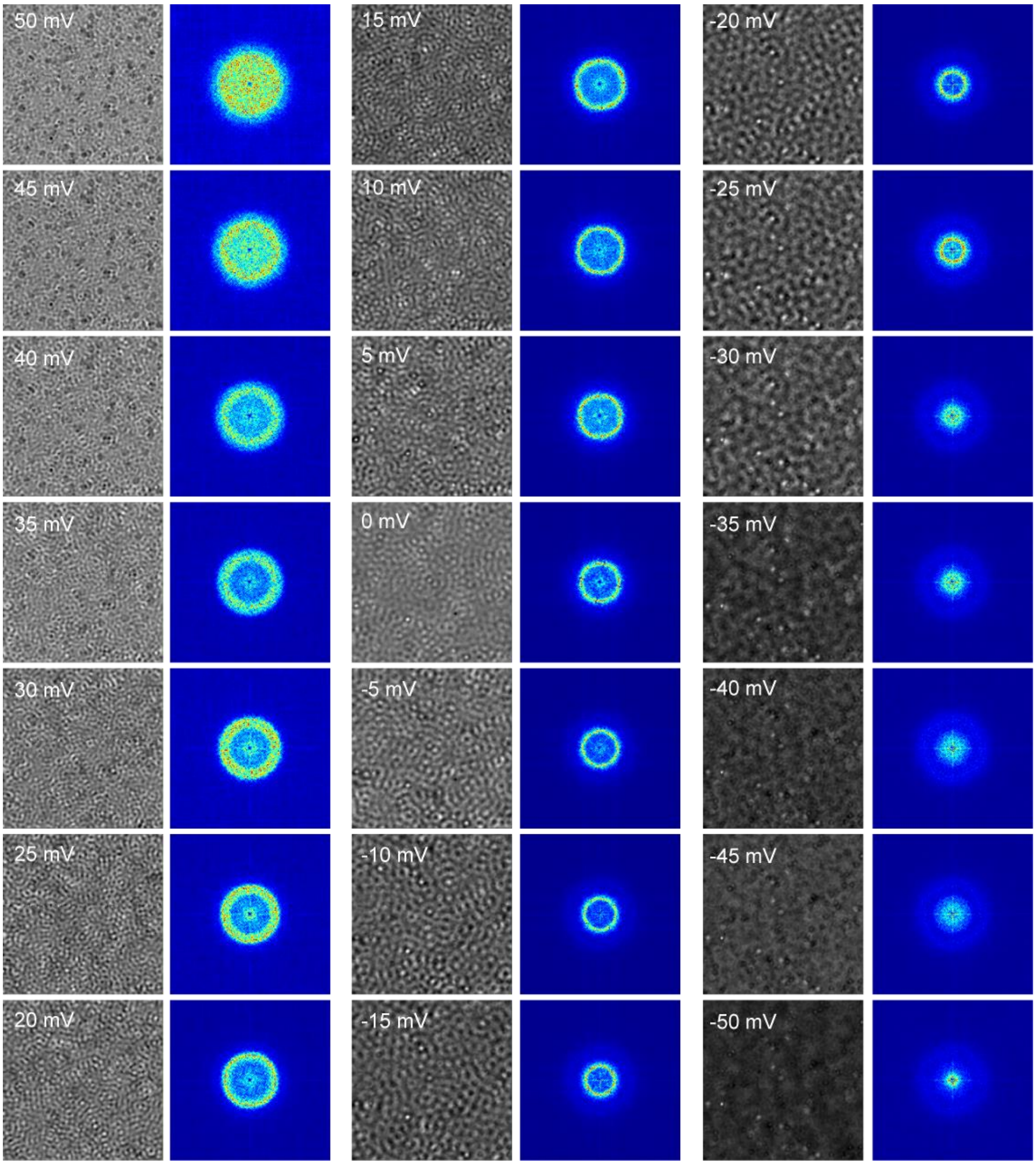

fig. S6. d*I*/d*V* maps and corresponding FFTs taken in an area of 100 × 100 nm^2 of the FeSe-terminated surface at K_c = 0.124 ML. Set point: V_b = 50 mV, I = 150 pA, ΔV = 3 mV. Each map has 200 × 200 pixels. The FFT images are four-fold symmetrized.