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Nanoscale layering of antiferromagnetic and superconducting phases in Rb2Fe4Se5

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We studied phase separation in a single-crystalline antiferromagnetic superconductor Rb2Fe4Se5 (RFS) using a combination of scattering-type scanning near-field optical microscopy (s-SNOM) and low-energy muon spin rotation (LE-mSR). We demonstrate that the antiferromagnetic and superconducting phases segregate into nanometer-thick layers perpendicular to the iron-selenide planes, while the characteristic in-plane size of the metallic domains reaches 10 mm. By means of LE-mSR we further show that in a 40-nm thick surface layer the ordered antiferromagnetic moment is drastically reduced, while the volume fraction of the paramagnetic phase is significantly enhanced over its bulk value. Self-organization into a quasiregular heterostructure indicates an intimate connection between the modulated superconducting and antiferromagnetic phases.

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