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Coexistence of superconductivity and antiferromagnetism in ($Li_{0.8}Fe_{0.2}$)OHFeSe

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In this talk, we report the synthesis of an air-stable material, ($Li_{0.8}Fe_{0.2}$)OHFeSe, which shows superconducting transition temperature up T_c to ~40 K, by means of a novel hydrothermal method [1]. The crystal structure is unambiguously determined by a combination of X-ray and neutron powder diffraction and nuclear magnetic resonance. Moreover, antiferromagnetic order is found to coexist with superconductivity. We also grew single crystals of (Li,Fe)OHFeSe, and observed a first-order transition from superconductor to AFM insulator with a strong charge doping induced by ionic gating in the thin flakes of single crystal [2]. T_c is continuously enhanced with electron doping by ionic gating up to a maximum T_c of 43 K, and a striking superconductor-insulator transition occurs just at the verge of optimal doping with highest T_c. A novel phase diagram of temperature-gating voltage with the superconductor-insulator transition is mapped out, indicating that the superconductor-insulator transition is a common feature for unconventional superconductivity. References: [1] X. F. Lu, N. Z. Wang, H. Wu, Y. P. Wu, D. Zhao, X. Z. Zeng, X. G. Luo, T. Wu, W. Bao, G. H. Zhang, F. W. Huang, Q. Z. Huang, X. H. Chen, Nature Mater. **14**, 352 (2015). [2] B. Lei, Z. J. Xiang, X. F. Lu, N. Z. Wang, J. R. Chang, S. Chang, A. M. Zhang, Q. M. Zhang, X. G. Luo, T. Wu, Z. Sun, and X. H. Chen, arXiv: 1503.02457.