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High temperature superconductivity in single unit-cell FeSe films on $SrTiO_3$

LILI WANG, Tsinghua University

High transition temperature (T_C) superconductivity was discovered in single unit-cell thick FeSe films grown on a $SrTiO_3$(001) substrate by molecular beam epitaxy. *In situ* scanning tunneling microscopy revealed a superconducting gap as large as 20 meV in single unit-cell thick FeSe films [1]. By *ex situ* transport measurements on single unit-cell thick FeSe films protected with FeTe layer, we demonstrated an onset T_C above 40 K and a critical current density $J_C \sim 1.7 \times 10^6$ A/cm^2 at 2 K, which are much higher than $T_C \sim 8$ K and $J_C \sim 10^4$ A/cm^2 for bulk FeSe [2,3], and that the characteristics of the transition are consistent with a two-dimensional superconductor undergoing a Berezinskii-Kosterlitz-Thouless transition. The superconductivity is further confirmed by measuring Meissner effect. The simple structure of the current system provides an ideal platform for understanding the underlying physics of high-T_C superconductivity.

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[2] Hsu, F. C. *et al.*, Superconductivity in the PbO-type structure α-FeSe. *Proc. Natl. Acad. Sci. USA* **105**, 14262 (2008).
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