Upper critical and irreversibility magnetic fields and transport properties of bulk K-, Ni-, and Co-doped $BaFe_2As_2$ pnictides for different granularities and their prospects in magnet design #230

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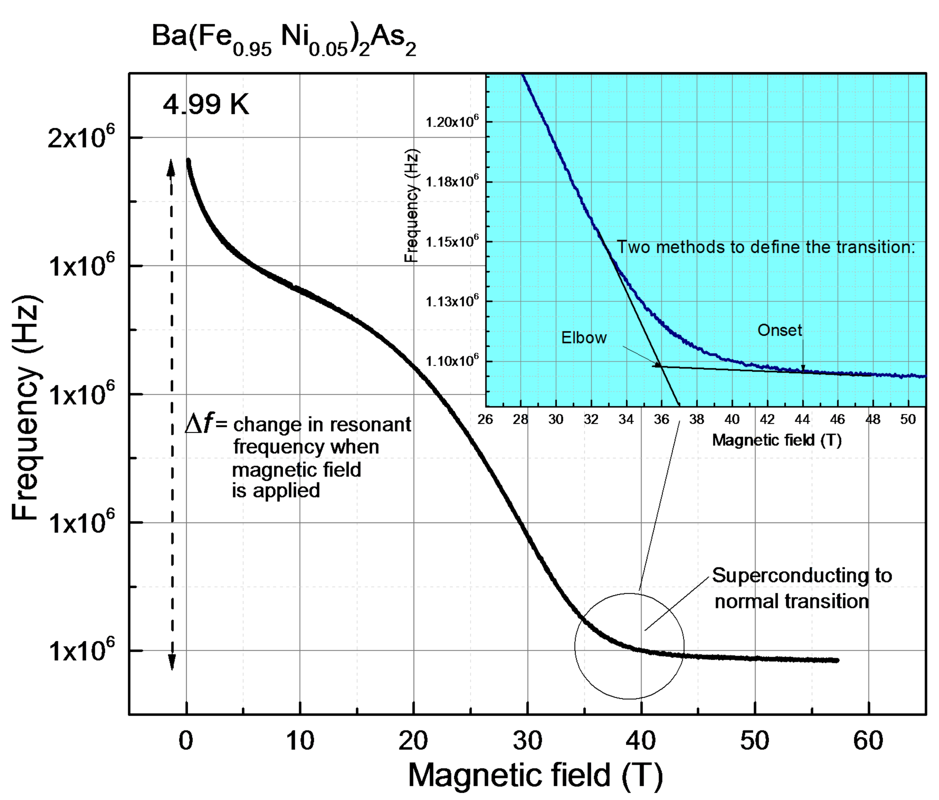
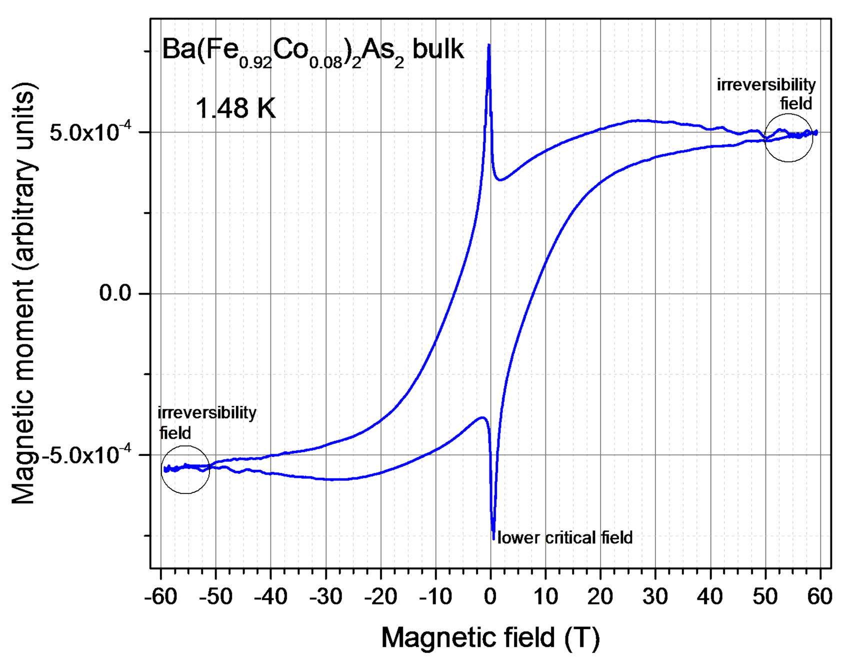
Measurement

Pulsed magnetic fields of up to 65 T were applied via radio frequency proximity detector oscillator (PDO) induction method: Place a superconducting sample in a small coil which is the inductive element of a resonant tank circuit. The exclusion of flux from the sample and the coil decreases the inductance of the circuit and the resonant frequency increases.



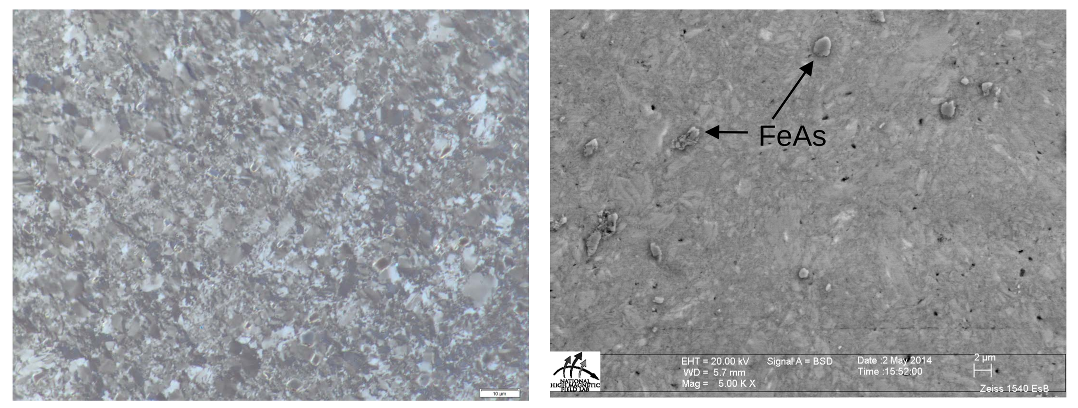


Conclusion

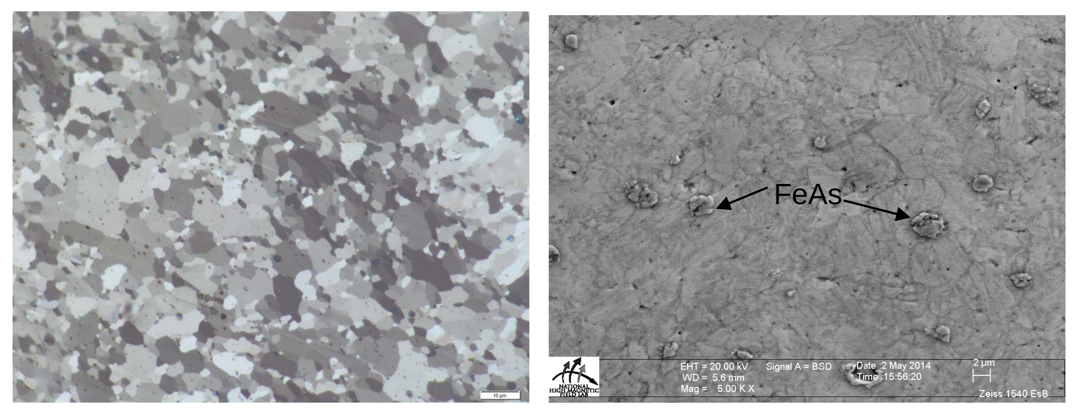
- The Fe-based superconductor, $(Ba_{0.6}K_{0.4})Fe_2As_2$, can generate tesla-scale fields with a polycrystalline bulk form. Because its *Tc* is the same as MgB_2 and because its *Hc2* is higher (>70 T versus <30 T), it shows more promise than REBCO or MgB_2 materials.
- K-doped Ba122 materials are suitable for making larger bulk magnets that can be magnetized to trap strong magnetic fields higher than 10 T.[1]
- Bulk Ba122 magnets can be fabricated by a scalable, versatile, and low-cost technique using ball milling, CIPping, and HIPping, common industrial ceramic processing techniques.[1] Their fracture toughness exceeds HIPped MgB_2, bulk YBCO, and is about equal to polycrystalline Al_2O_3.[1]

$(Ba_{0.6}K_{0.4})Fe_2As_2$ polycrystalline

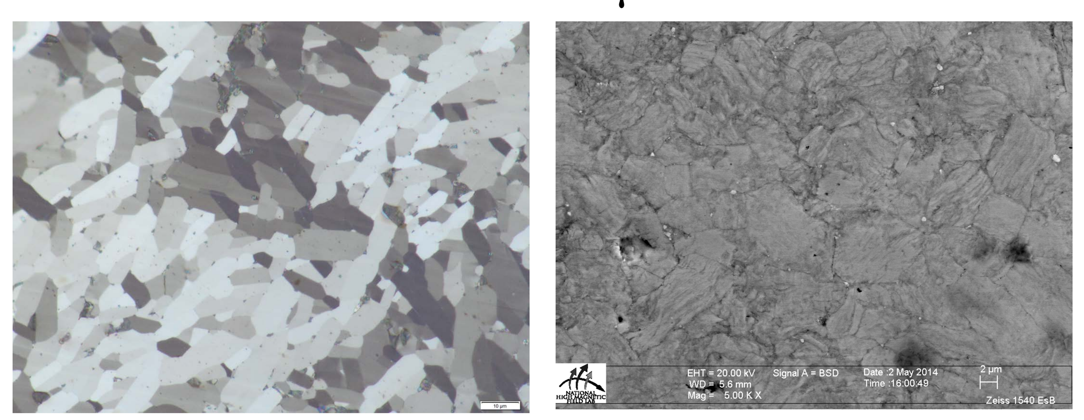
Optical Microscopy SEM



Grain diameter << 1 μm 600 C

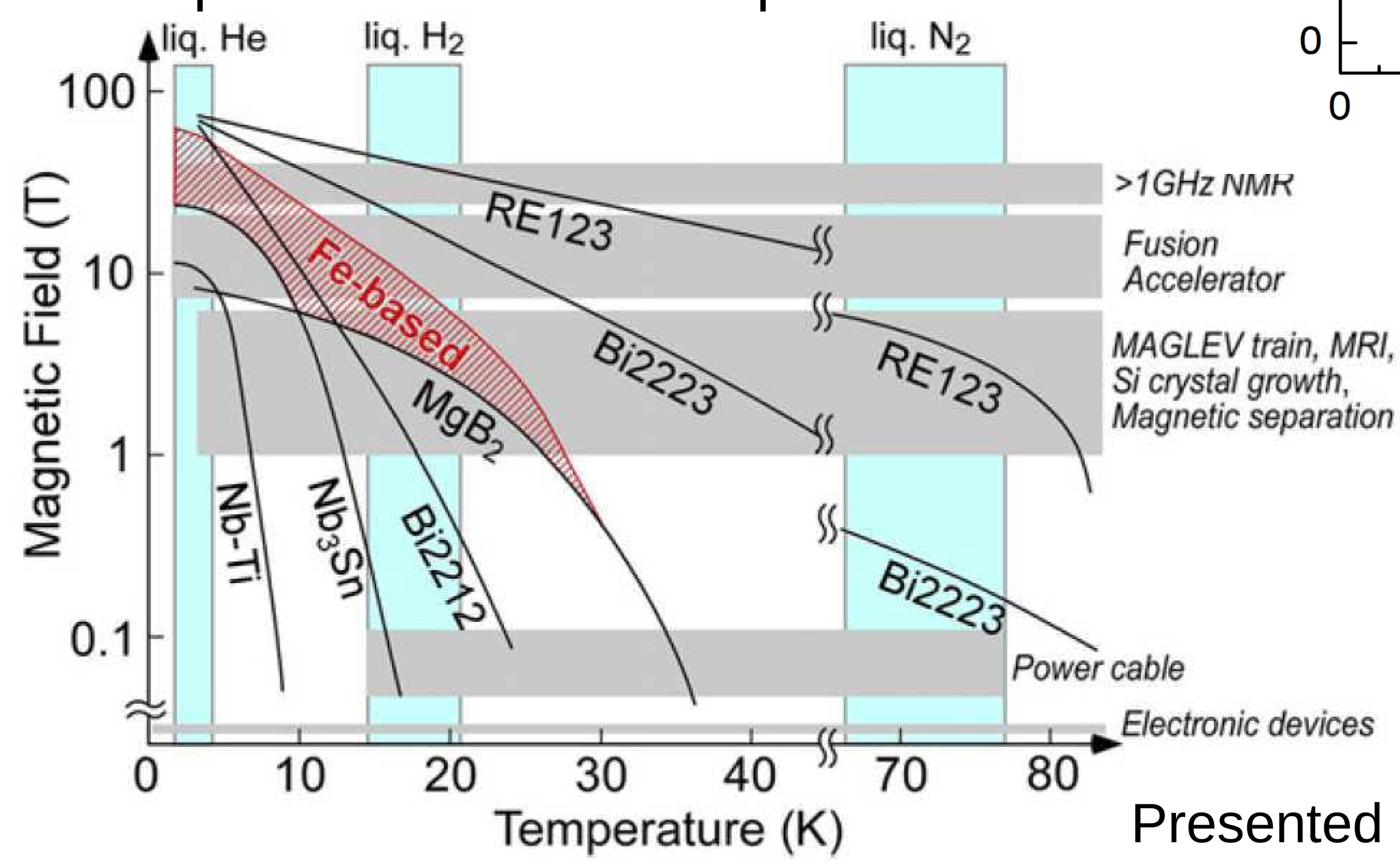


Grain diameter ~ 4.8 μm 900 C

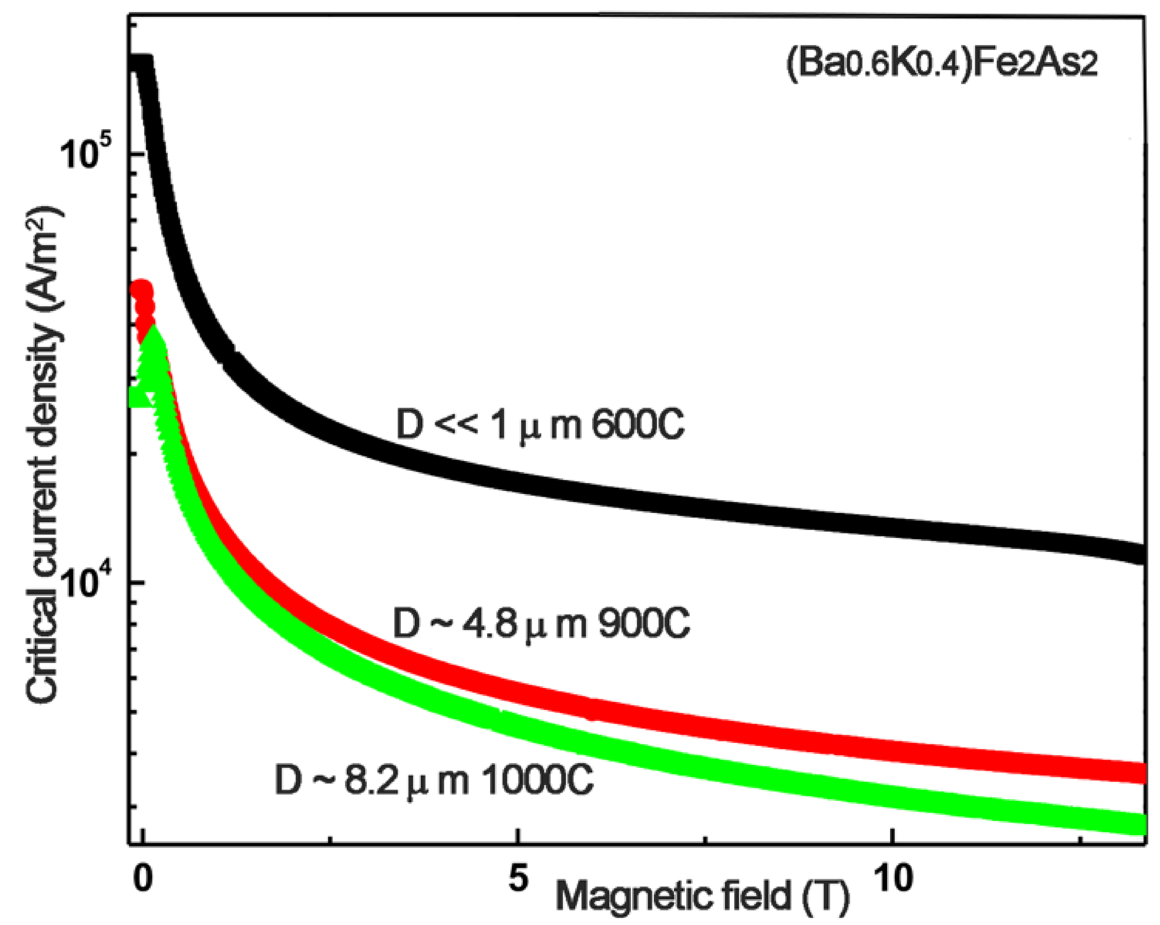


Grain diameter ~ 8.2 μm 1000 C

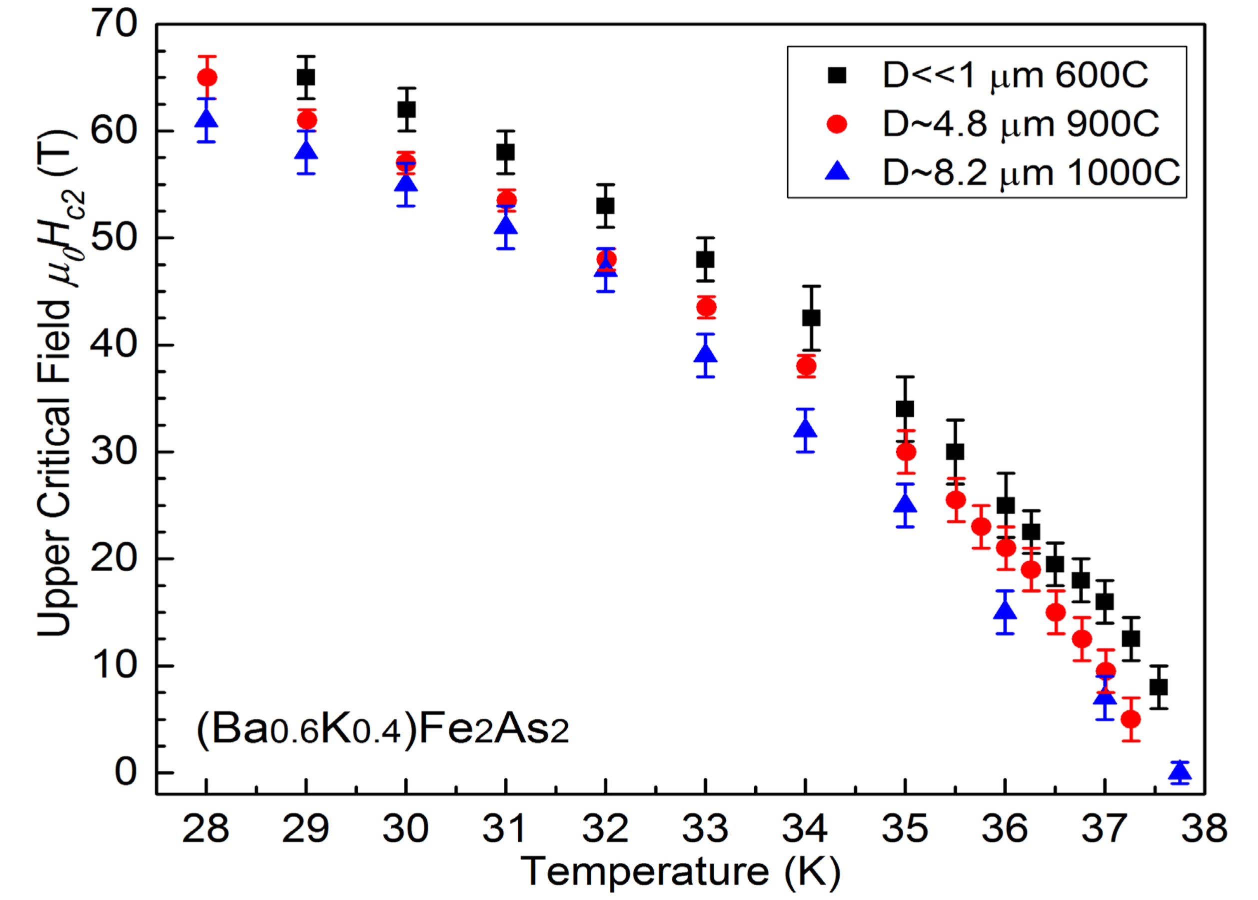
Comparison with other superconductors[2]

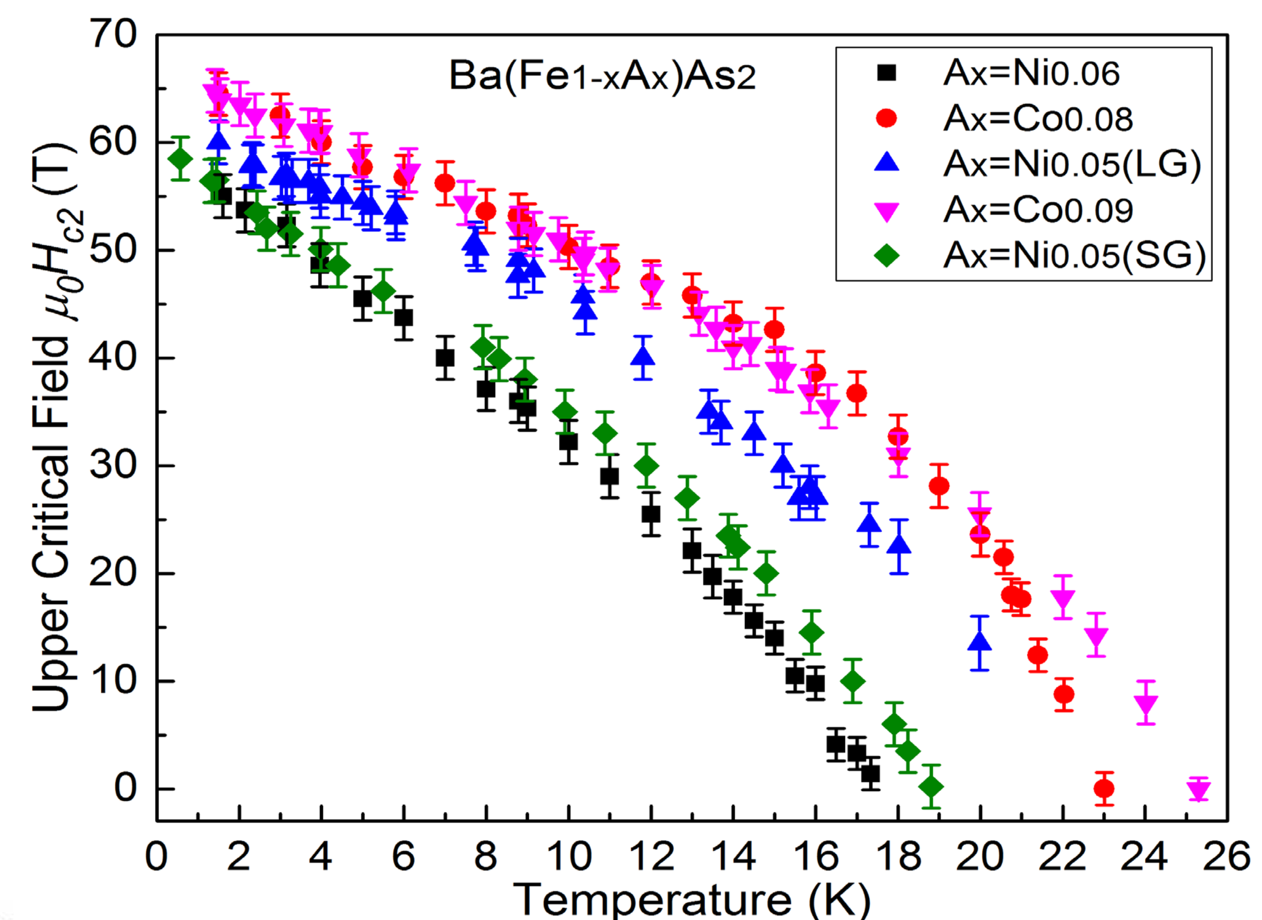


Results

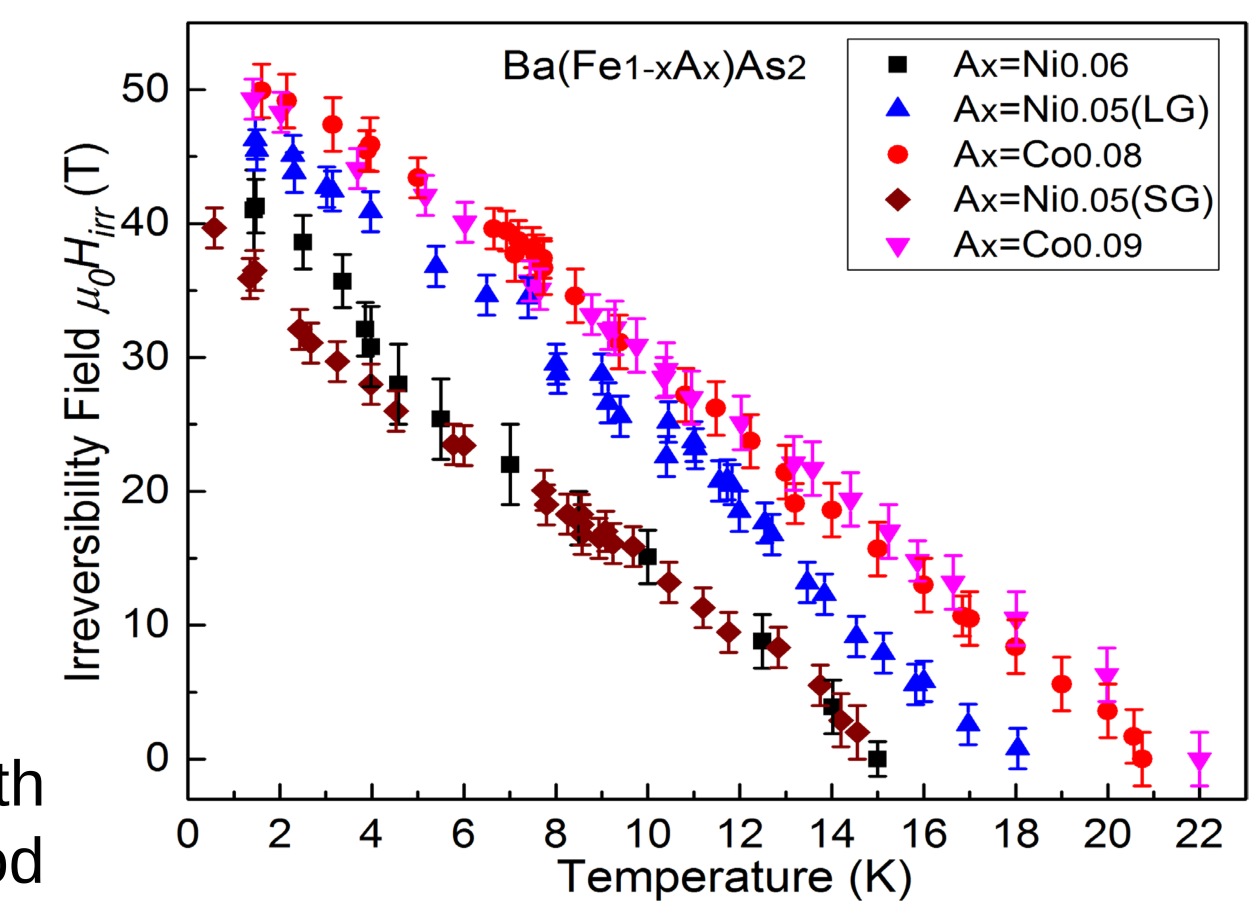


- For $(Ba_{0.6}K_{0.4})Fe_2As_2$ the global critical current density obtained from magnetization measurements is inversely proportional to grain radius reaching over 100 kAcm[2] at 5 K and 0 T





- Ni-doped samples with larger average grain size perform better
- Optimal grain size-large varies with stoichiometry and processing method



1. J. D. Weiss,et al, *Supercond. Sci.Technol.* 28, 112001, (2015).
2. J-I. Shimoyama, *Supercond. Sci. Technol.* 27, 044002 (2014).

Presented at 25th Conference on Magnet Technology, Aug.27-Sept.1, 2017, Amsterdam, Netherlands