Upper critical and irreversibility magnetic fields and transport properties of bulk K-, Ni-, and Co-doped BaFe$_2$As$_2$ pnictides for different granularities and their prospects in magnet design #230

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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.

• The Fe-based superconductor, (Ba$_{0.6}$K$_{0.4}$)Fe$_2$As$_2$, can generate tesla-scale fields with a polycrystalline bulk form. Because its $T_c$ is the same as MgB$_2$ and because its $H_{c2}$ is higher (>70 T versus <30 T), it shows more promise than REBCO or MgB$_2$ materials.

• K-doped Ba$_{122}$ materials are suitable for making larger bulk magnets that can be magnetized to trap strong magnetic fields higher than 10 T.$^1$

• Bulk Ba$_{122}$ 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$_2$O$_3$.$^1$

For (Ba$_{0.6}$K$_{0.4}$)Fe$_2$As$_2$ 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.

Comparison with other superconductors$^2$

Ni-doped samples with larger average grain size perform better.

Optimal grain size-large varies with stoichiometry and processing method.

Conclusion

Measurement

Results

• Ni-doped samples with larger average grain size perform better

Optimal grain size-large varies with stoichiometry and processing method
