**World record pinning force density for Fe-based superconductors**

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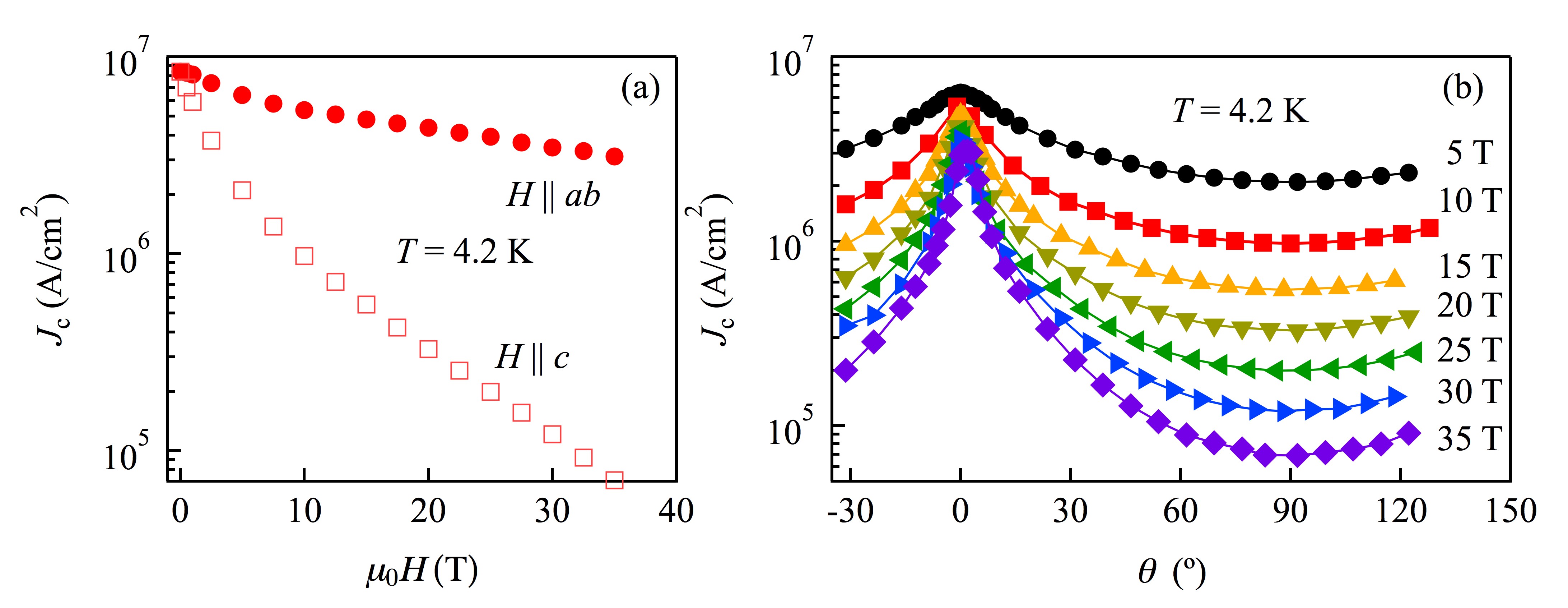
**Introduction**

The transport critical current density, *J*c, of an oxypnictide epitaxial thin film was measured at 4.2 K as a function of magnetic field and field orientation. Our NdFeAs(O,F) thin film showed a record pinning force density of over 1 TN/m3 at 35 T, which is the highest ever reported for Fe-based superconductors (FBS). This result highlights the potential of possible high-field applications using Fe-based superconductors.

**Experimental**

The epitaxial NdFeAs(O,F) thin film of 20 nm was grown by molecular beam epitaxy at Nagoya university. For transport measurements, a small bridge of 70 m width and 1 mm length was prepared by a laser cutter at ASC-NHMFL. DC magnetic fields up to 35 T (at DC facilities at NHMFL) were applied and *J*c measured in maximum Lorentz force configuration.

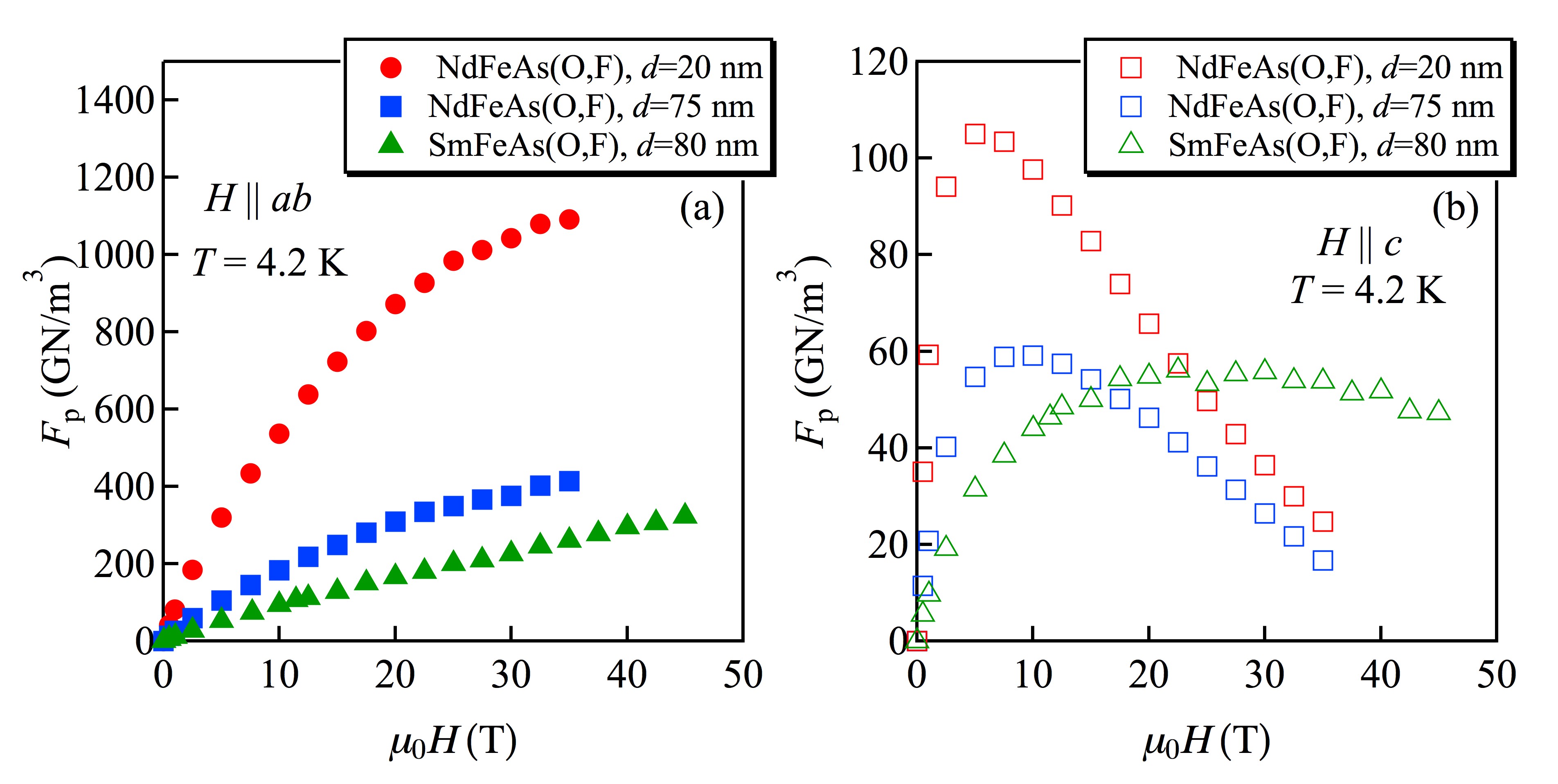
**Fig.1** (a) Field and (b) angular dependence of a NdFeAs(O,F) thin film at 4.2 K.



**Results and Discussion**

Self-field *J*c of 8.6 MA/ cm2 was recorded at 4.2 K. Applying a magnetic field suppresses *J*c largely for *H*//*c*, whereas the *J*c reduction for *H*//*ab* is not so significant (Fig. 1(a)). This indicates anisotropy in physical parameters and/or geometry. Angular dependence of *J*c showed no sign of *c*-axis correlated defects (Fig. 1(b)).

Figure 2 compares the pinning force density, *F*p, for several oxypnictides measured at NHMFL [1-2]. Clearly the present NdFeAs(O,F) thin film showed the highest *F*p for both crystallographic directions. Note that *F*p for *H*//*ab* does not reach the maximum value even at 35 T. To the best of our knowledge, *F*p over 1 TN/m3 is the highest value ever reported for FBS.



**Fig.2** *F*p for various oxypnictides (a) *H*//*ab* and (b) *H*//*c* at 4.2 K. The date of SmFeAs(O,F) with *d*=80 nm and NdFeAs(O,F) with *d*=75 nm are taken from refs. [1] and [2], respectively.

**Conclusions**

The results show the potential that FBS could have for high-field applications.

**Acknowledgements**

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**References**

[1] Iida, K., *et al*., Sci. Rep., **3**, 2139 (2013).

[2] Tarantini, C., *et al*., Sci. Rep., **6**, 36047 (2016).