

**Supplementary information on “High  $J_c$  and low anisotropy of hydrogen doped NdFeAsO superconducting thin film”**

Kazumasa Iida<sup>1,6</sup>, Jens Hänisch<sup>2</sup>, Keisuke Kondo<sup>1</sup>, Mingyu Chen<sup>1</sup>, Takafumi Hatano<sup>1,6</sup>, Chao Wang<sup>3</sup>, Hikaru Saito<sup>4,6</sup>, Satoshi Hata<sup>3,5,6</sup>, and Hiroshi Ikuta<sup>1</sup>

<sup>1</sup>*Department of Materials Physics, Nagoya University, Chikusa-ku, Nagoya 464-8603, Japan*

<sup>2</sup>*Institute for Technical Physics, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany*

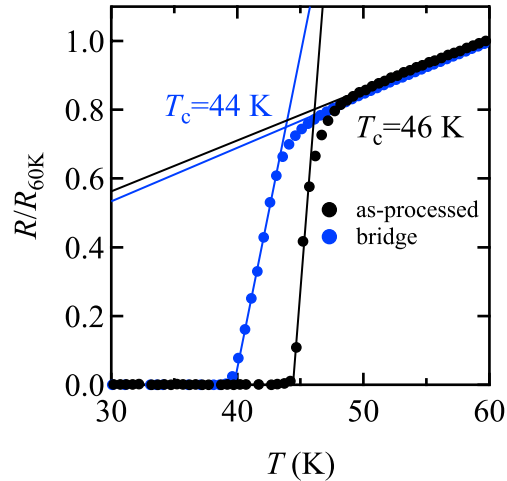
<sup>3</sup>*The Ultramicroscopy Research Center, Kyushu University, Nishi-ku, Fukuoka 819-0395, Japan*

<sup>4</sup>*Institute for Materials Chemistry and Engineering, Kyushu University, Kasuga, Fukuoka 816-8580, Japan*

<sup>5</sup>*Faculty of Engineering Sciences, Kyushu University, Kasuga, Fukuoka 816-8580, Japan*

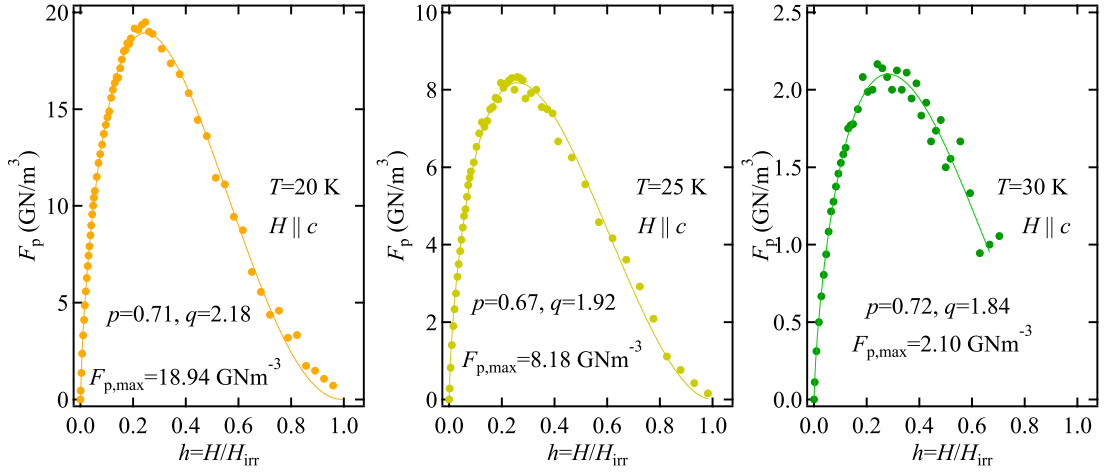
<sup>6</sup>*JST CREST, Kawaguchi, Saitama 332-0012, Japan*

**1. The effect of microbridge processing on the superconducting transition temperature.**



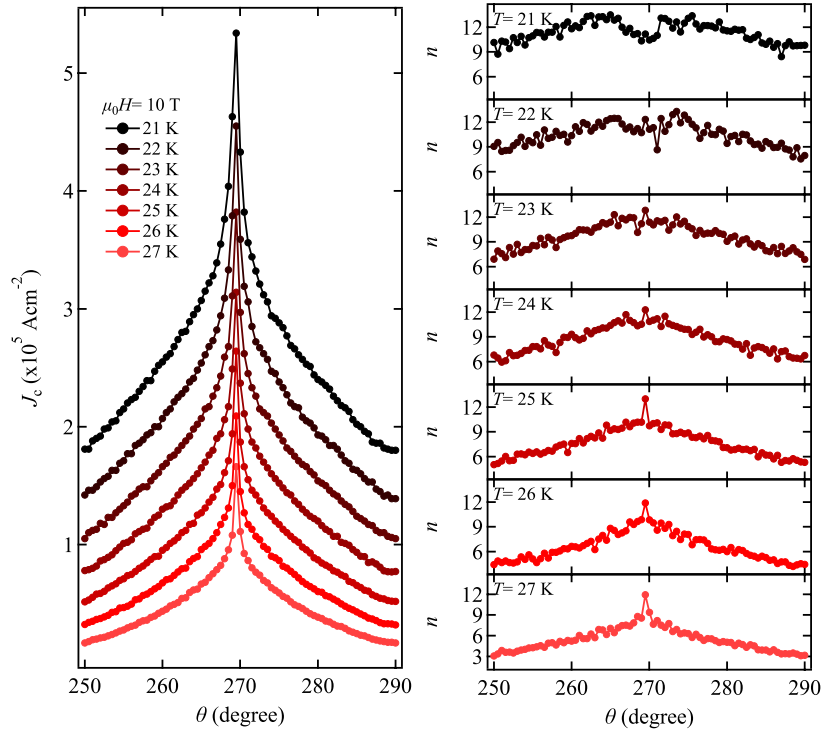
**Figure S1. Normalised resistance as a function of temperature.** The as-processed sample showed a  $T_c$  of 46 K. After fabrication, the bridge sample showed a  $T_c$  of 44 K.

## 2. The pinning force analysis.

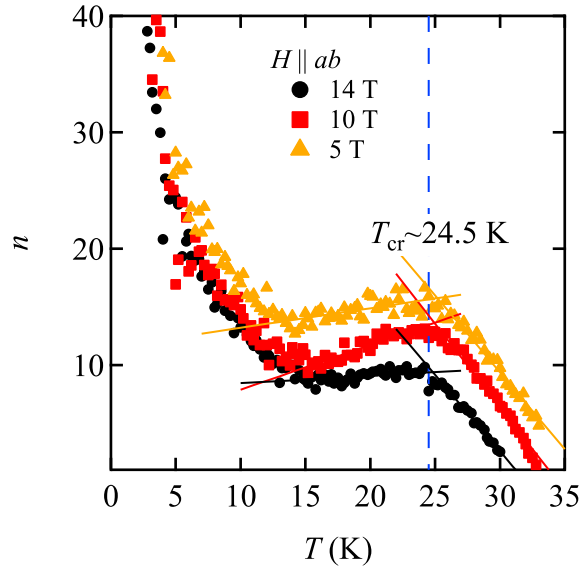


**Figure S2.** Pinning force density  $F_p$  as a function of reduced field for  $H \parallel c$ . Exponents  $p$  and  $q$  in  $h^p(1-h)^q$  are evaluated for each temperature. The results are summarised in fig. 4e.

## 3. Determining the dimensional cross-over temperature $T_{cr}$ .

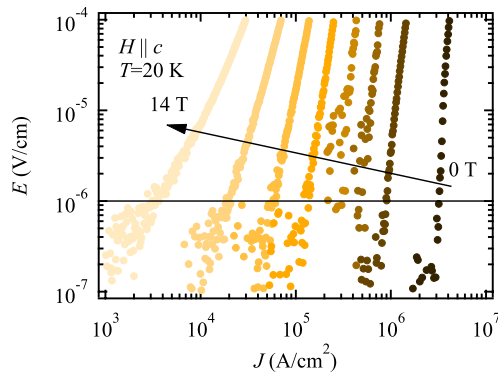


**Figure S3.** Angular dependence of  $J_c$  and the corresponding  $n$  under a fixed magnetic field of 10 T measured at various temperatures. As the temperature decreases from 27 K, the exponent  $n$  around  $\theta \sim 270^\circ$  (i.e.  $H \parallel ab$ ) starts showing shoulders at 24 K, followed by a dip formation.



**Figure S4. Temperature dependence of  $n$  for  $H \parallel ab$  under several magnetic fields.** The exponent  $n$  increases with decreasing  $T$  and stays constant around 24.5 K. Below 15 K,  $n$  starts to increase again with decreasing  $T$ .

#### 4. $E$ - $J$ curves for determining $J_c$ .



**Figure S5. Representative  $E$ - $J$  curves.**  $E$ - $J$  curves at 20 K for  $H \parallel c$ . Field increment was 2 T.  $J_c$  was determined as the intersection between  $E=1 \mu\text{V}/\text{cm}$  and each curve.