Characterization of Recent CPRD Bi-2212 Wires

Jianyi Jiang, Shaon Barua, Jozef Kvitkovic, F. Kametani, U. P. Trociewitz, E. E. Hellstrom, and D. C. Larbalestier

Applied Superconductivity Center,
National High Magnetic Field Laboratory
Florida State University

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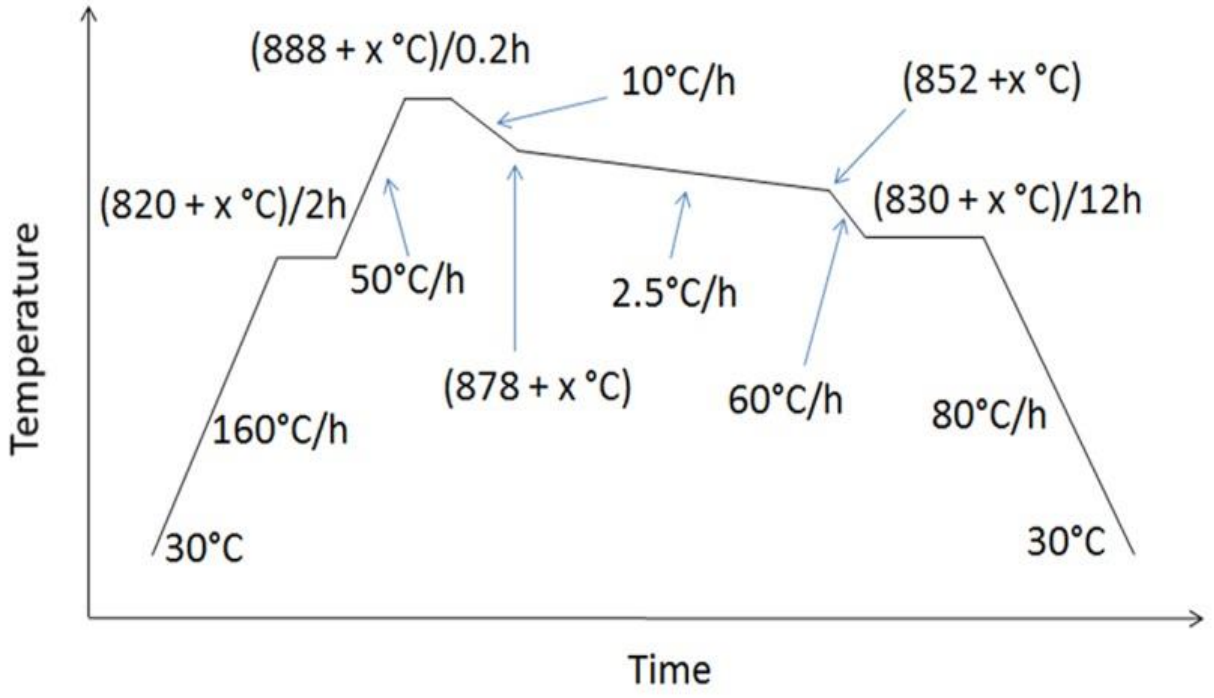
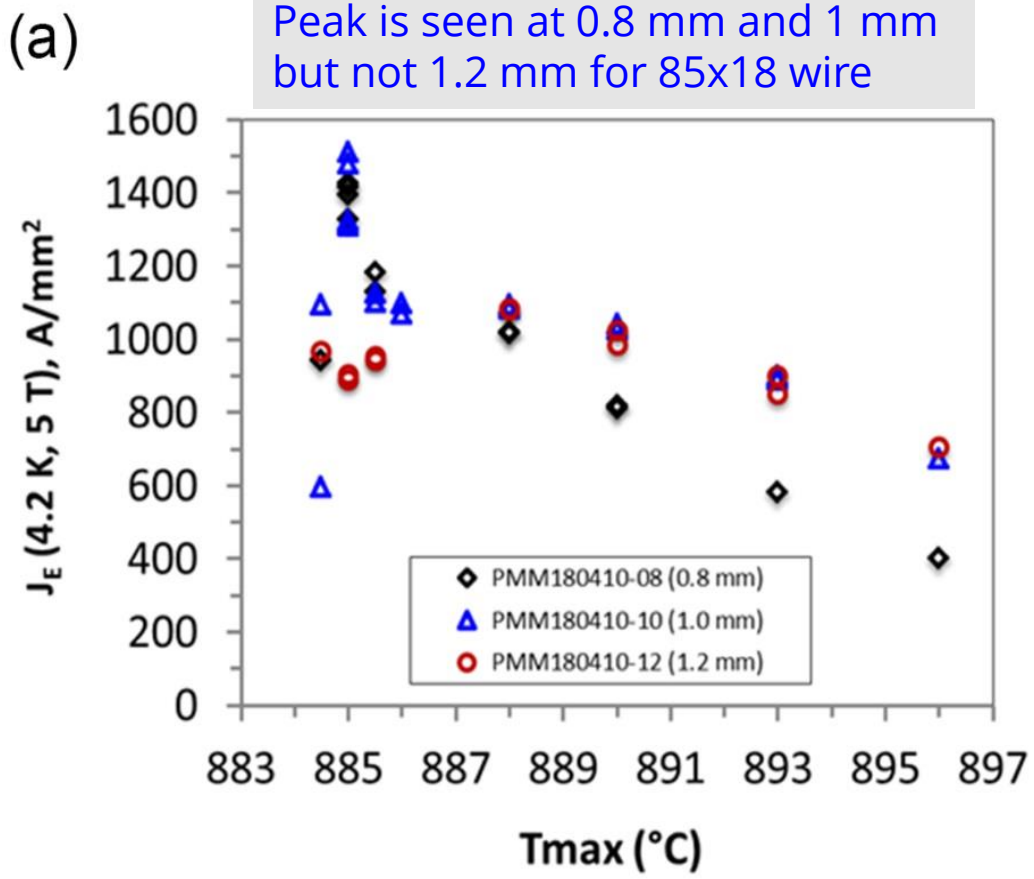
Recent CPRD Bi-2212 billets

- One 10kg billet in 2018
  - PMM180627 (1.0 mm, 55x18, delivered in 5 pieces)
- Two 10kg billets in 2019
  - PMM190118 (0.8 mm, 55x18)
  - PMM191004 (0.8 mm, 55x18)
- One 10kg billet in 2021
  - PMM211105 (1.0 mm, 55x18, 1.3 km)
- One 10kg billet in 2022
  - PMM220329 (1.0 mm, 55x18, 1.3 km)

Standard 50 bar overpressure heat treatment

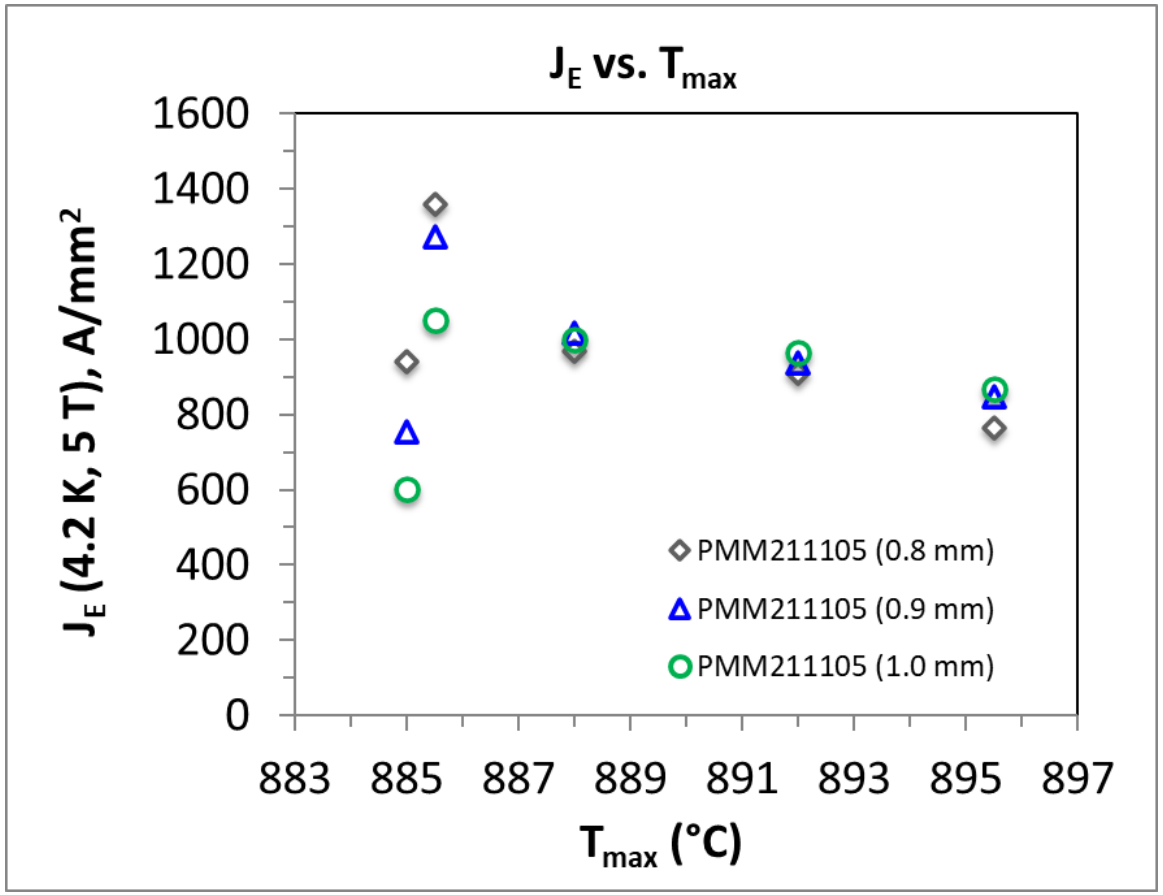


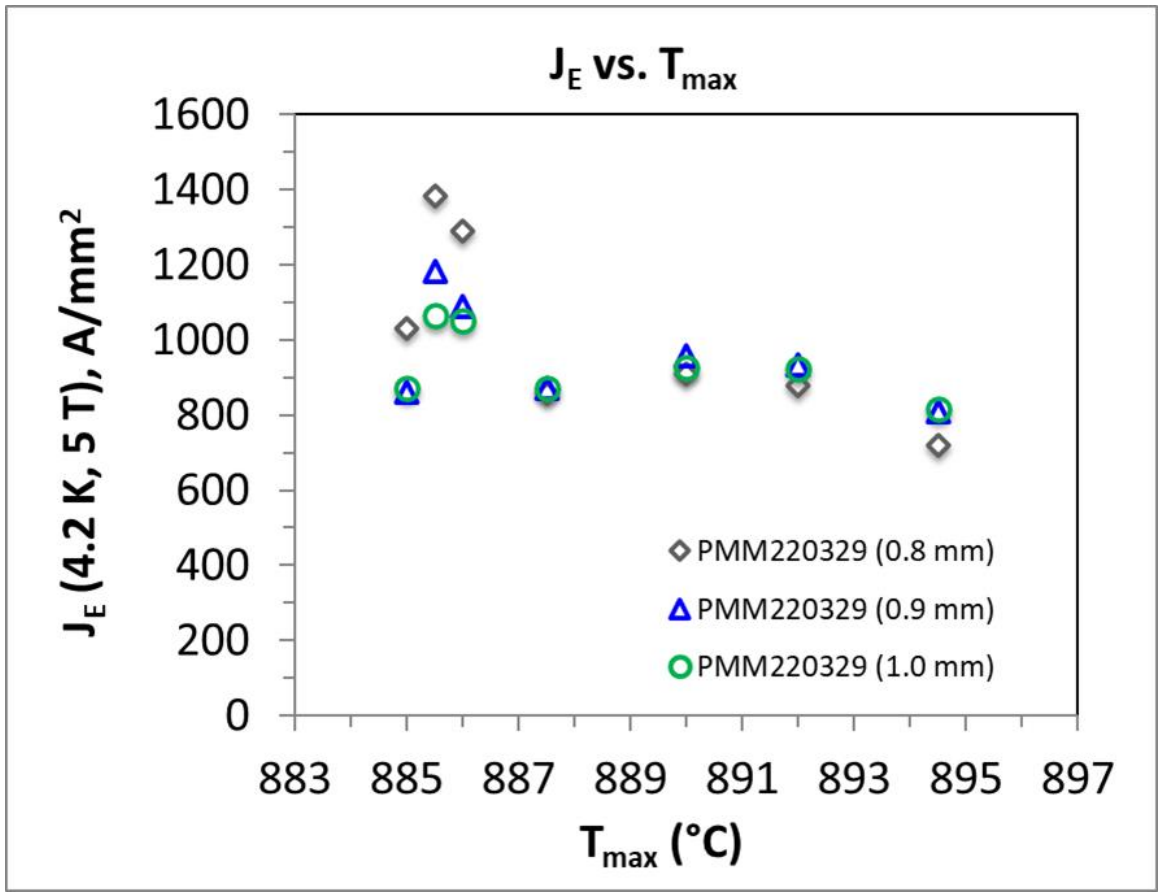
Peak is seen at 0.8 mm and 1 mm but not 1.2 mm for 85x18 wire



Jiang et al., *IEEE Trans. Appl. Supercond.* 31, 6400206 (2021)

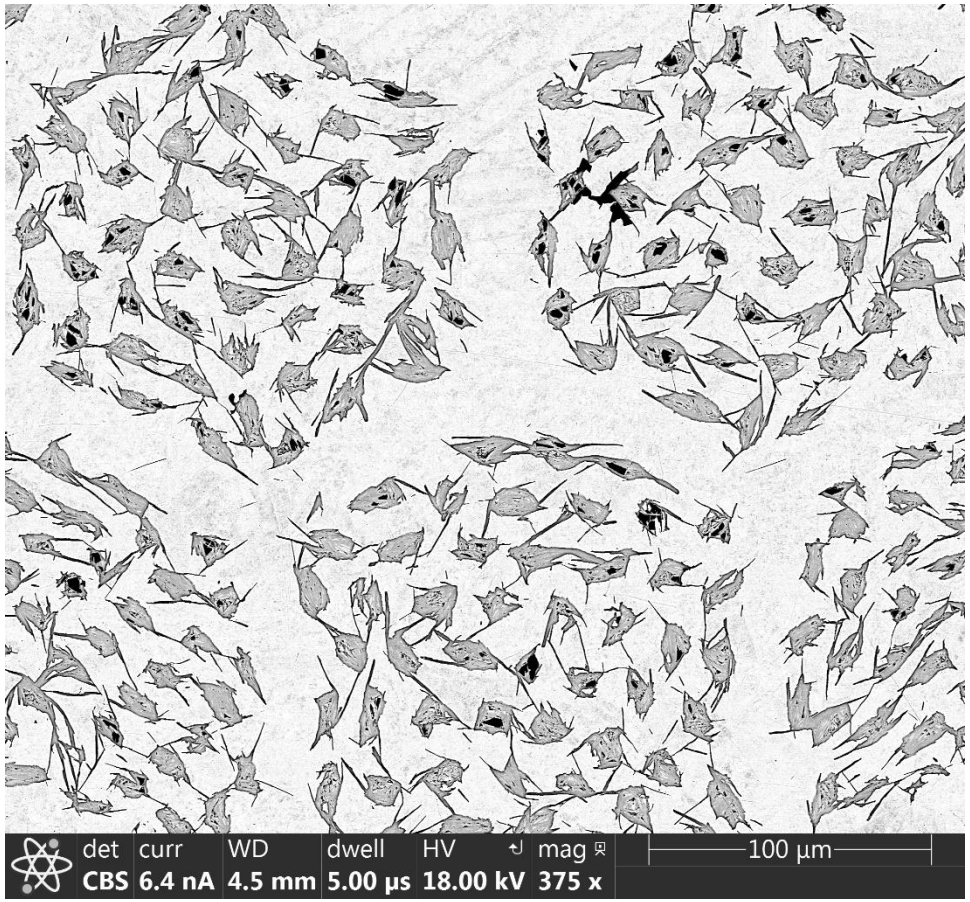
J_E(4.2K,5T) for PMM211105 (55x18) and PMM220329 (55x18)



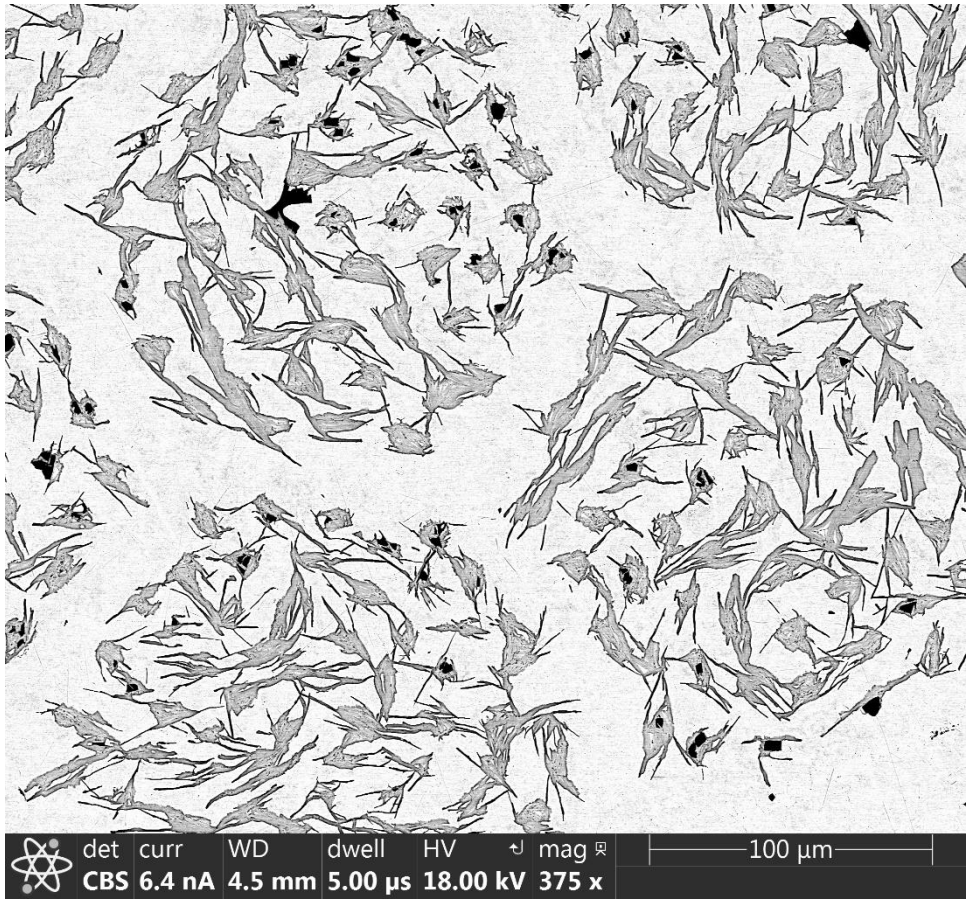


SEM images of 1.0 mm PMM211105 (55x18) after OP-HT

T_{max} = 885.5 °C

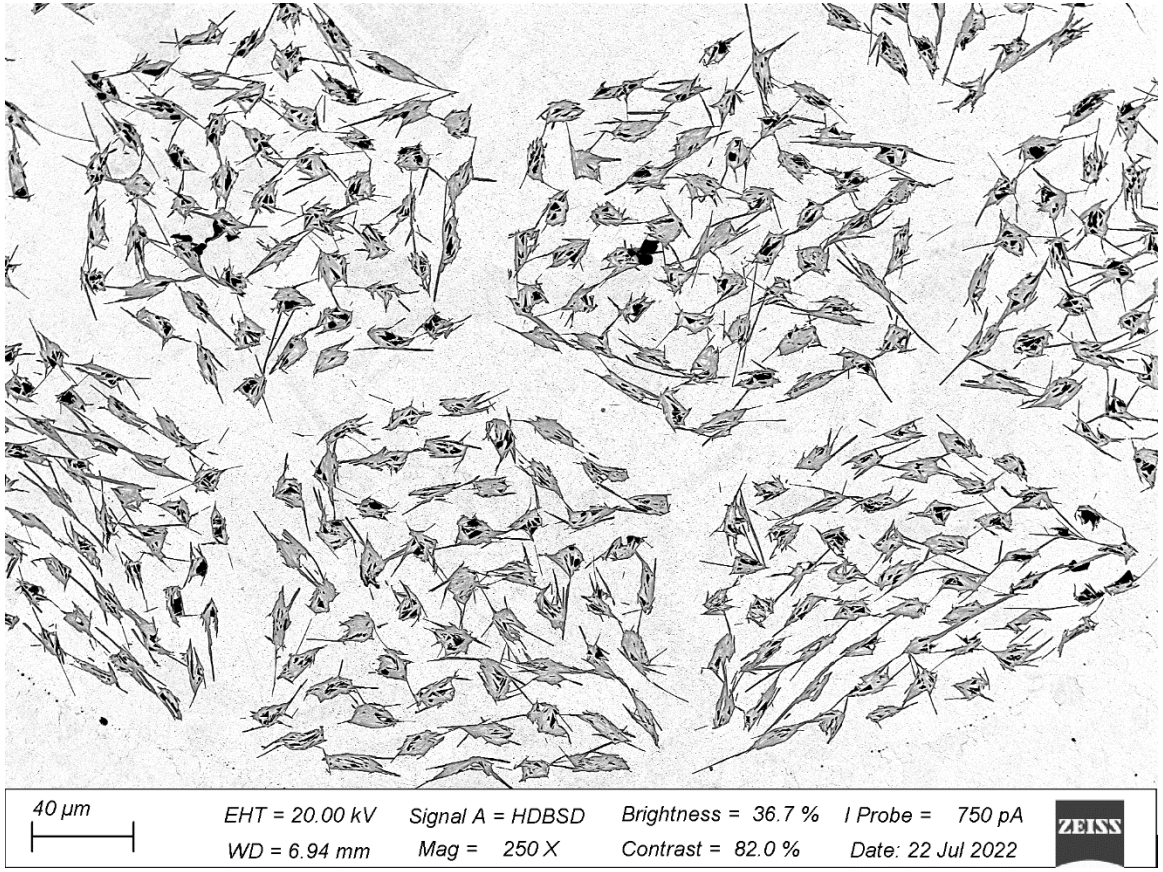


T_{max} = 892 °C

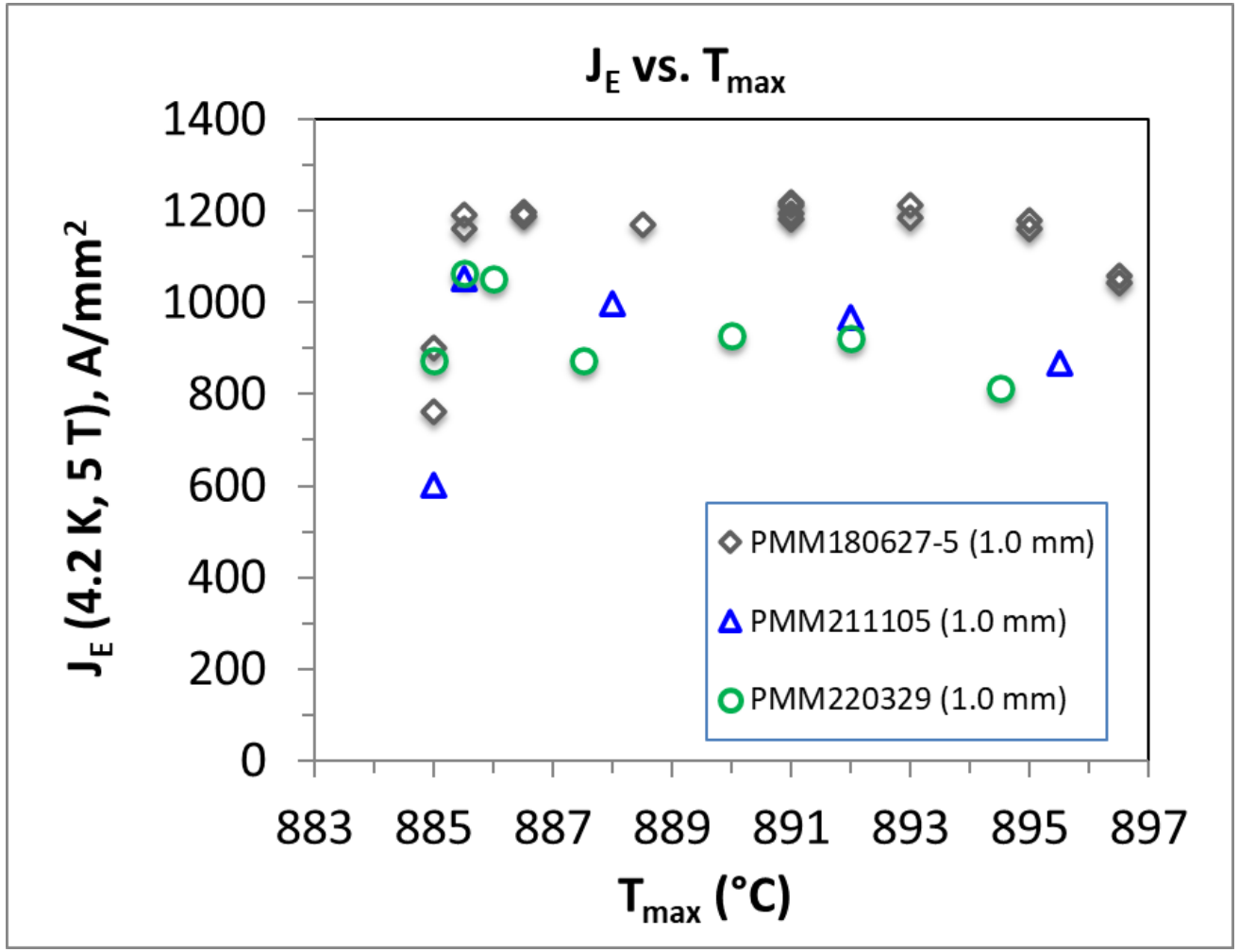


SEM images of 1.0 mm PMM220329 (55x18) after OP-HT

T_{max} = 885.5 °C

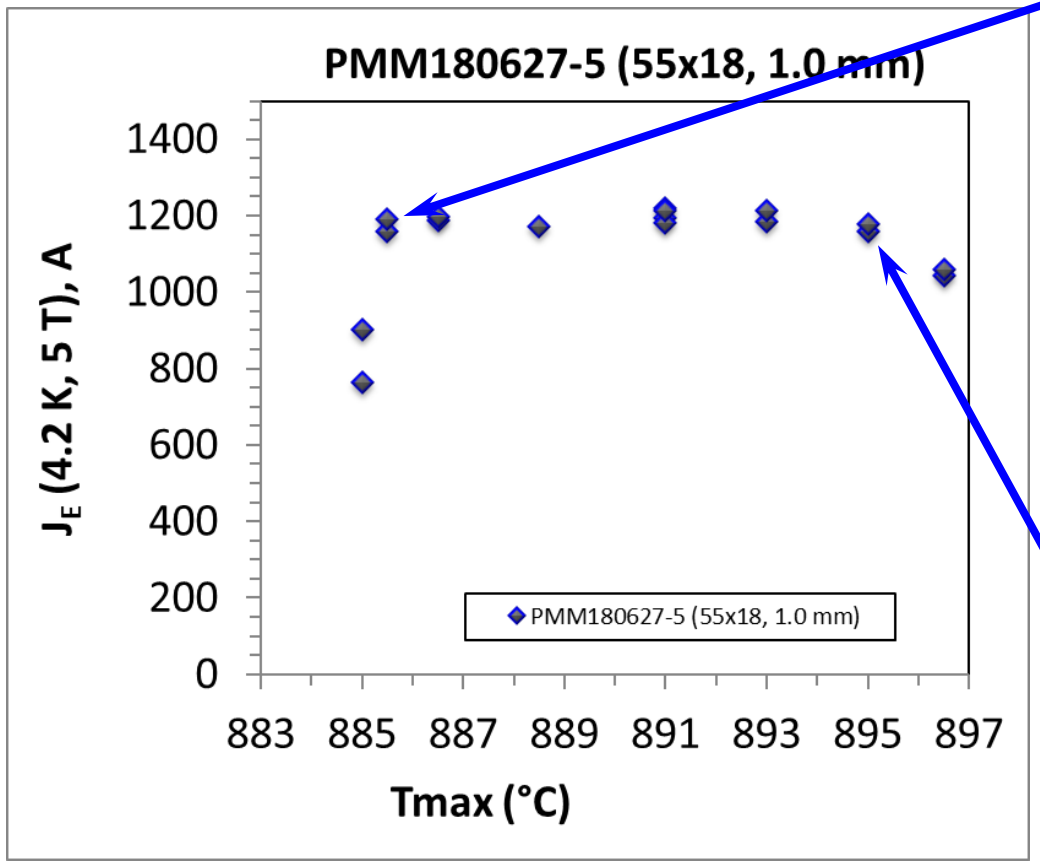


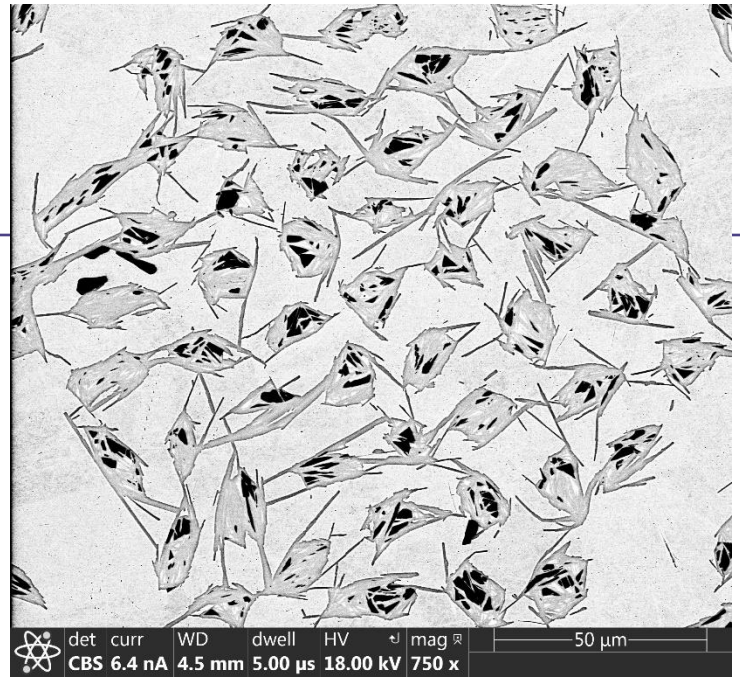
Comparison of three 55x18 wires with diameter of 1.0 mm



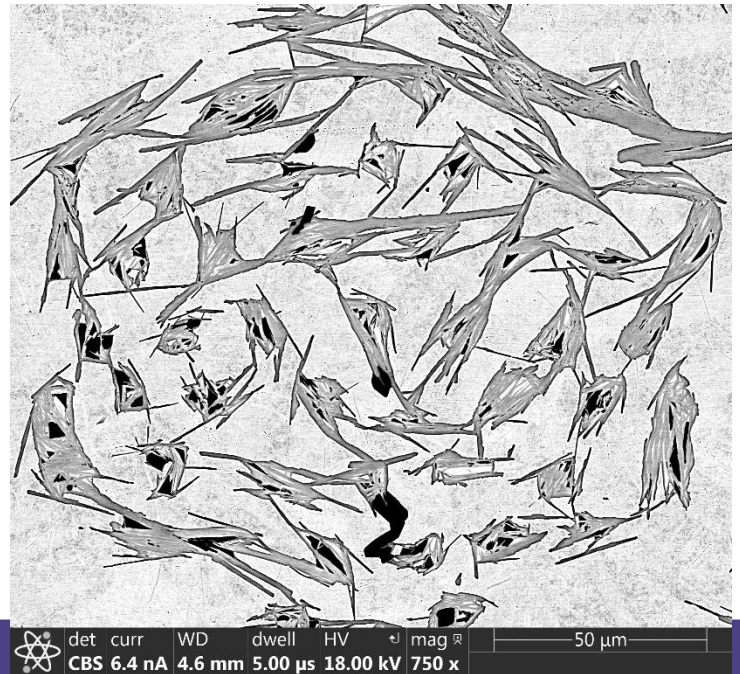
- **PMM180627 is the best.**
- **PMM180627 has higher and wider J_E plateau.**
- **We need to understand what causes the different performance.**

Higher and wider J_E plateau



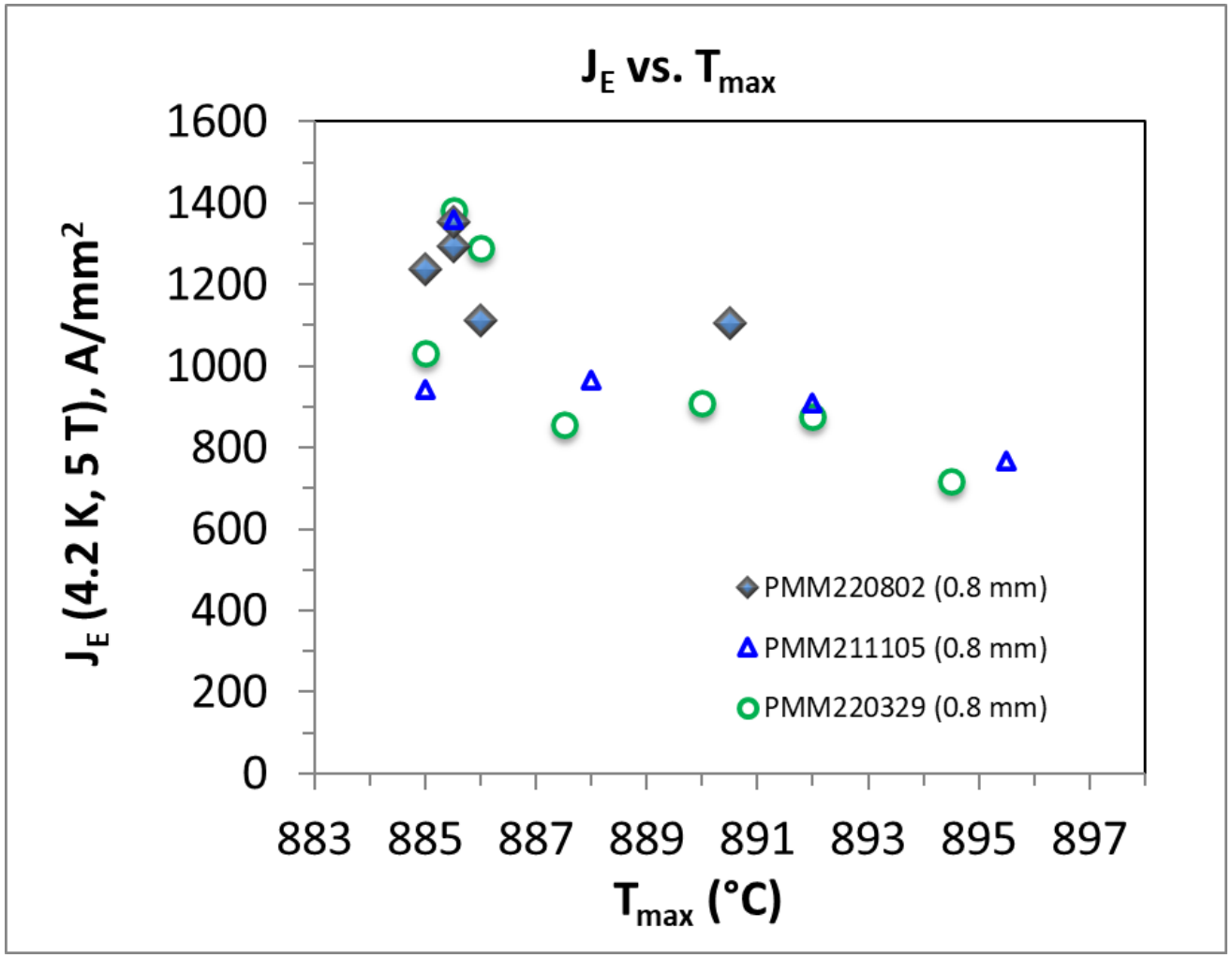


T_{max} = 885.5 °C



T_{max} = 895 °C

Comparison of 55x18 billets (PMM211105 and PMM220329) with new 37x18 billet (PMM220802)

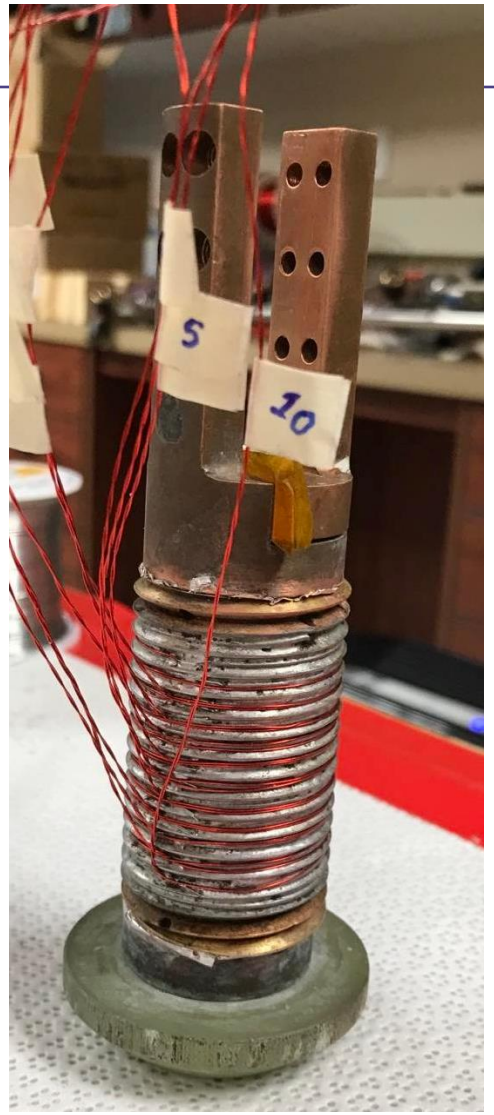


- PMM220802 is a new 2kg Engi-Mat SBIR billet with 37x18 architecture.
- 37x18 seems to be a good architecture for 0.8 mm wire.

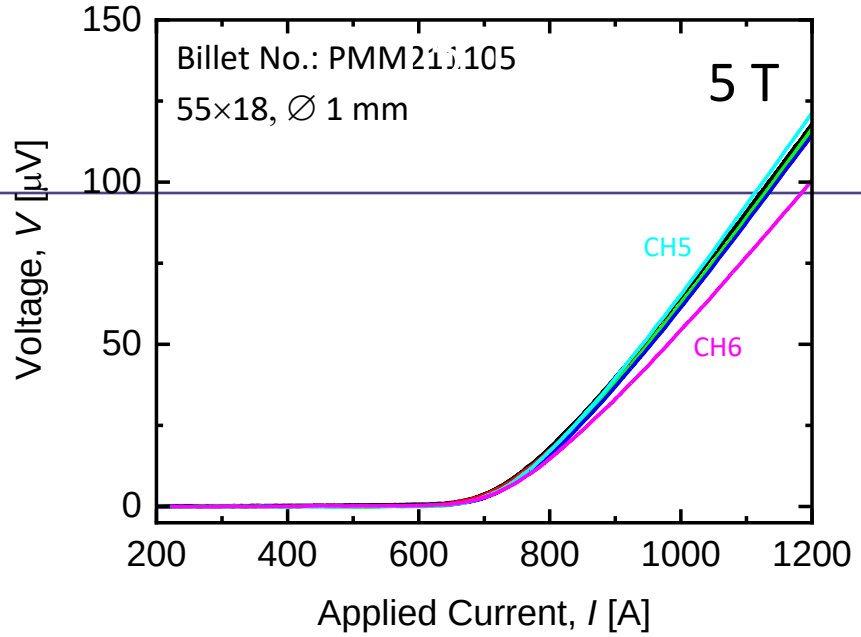
I_c distribution measurement for wire PMM211105-barrel (1.0 mm)

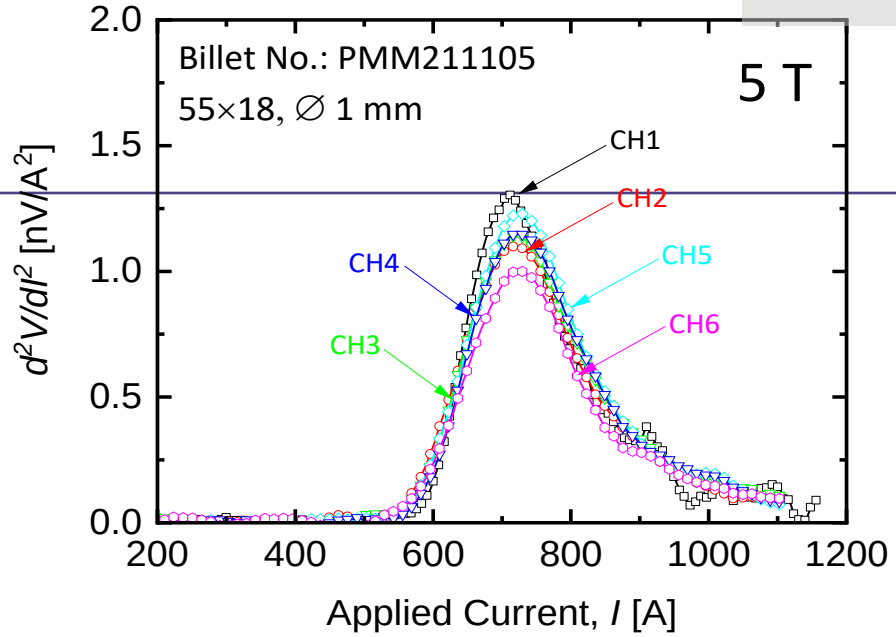
Billet No.	Powder	Diameter [mm]	No. of Filaments	Filling Factor	T_{max} [°C]	t_{melt} [h]	T_c^{onset}	H_K [T]	α	J_c (5 T, 4.2 K) [A/mm^2]†
PMM211105		1.0	55×18		888.5	3.9				
PMM210115		1.0	27×18	0.065	888	3.7			0.255	3695
PMM180627	LXB 131	1.0	55×18	0.217	888.5	3.9			0.264	5270
PMM180410	LXB 116	1.0	85×18	0.201	885	2.4	85.20	8.9	0.286	7115
PMM180410	LXB 116	1.0	85×18	0.201	887.5	3.5	84.73		0.272	5565
PMM180410	LXB 116	1.0	85×18	0.201	896	7.1	84.08		0.258	5095
PMM140606	Lot 82	1.0	55×18	0.220	890	3.9			0.251	3440
PMM110106-1	Lot 77	1.0	85×18	0.211	890	3.9	83.20		0.263	4535
PMM100913	Lot 77	0.8	37×18	0.221	890	4.1	83.38		0.259	4085

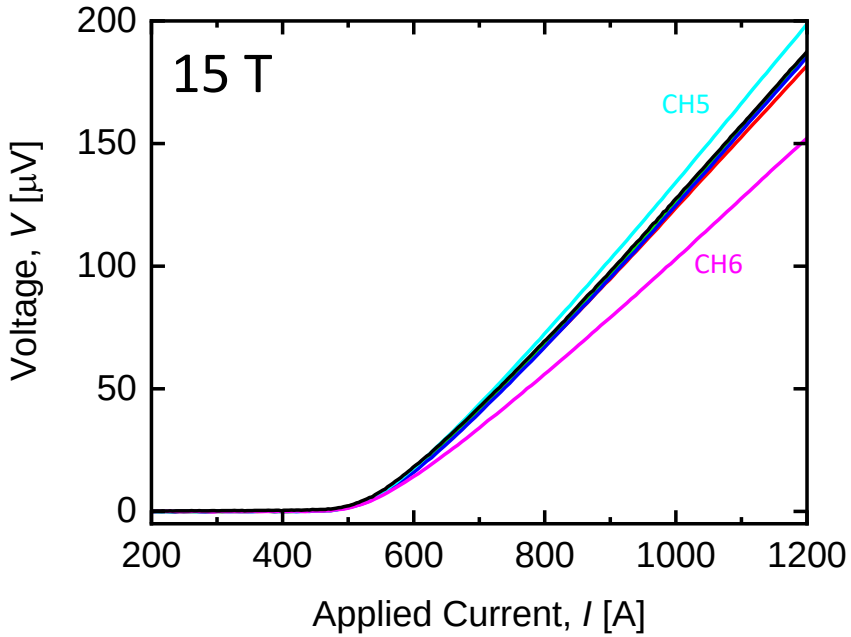
Sample: 220831-PMM211105-barrel (1.0 mm wire)

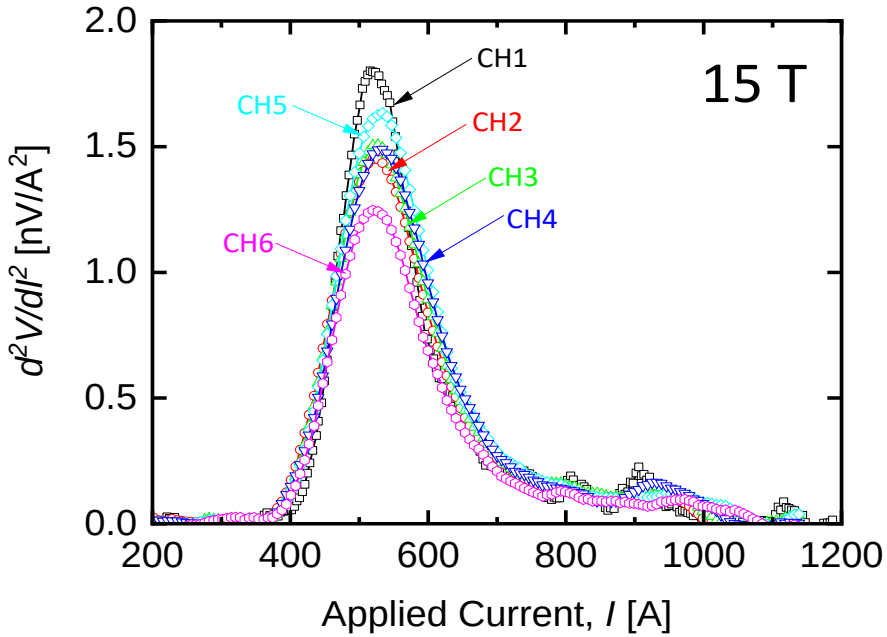


Slides from Shaon Barua


Billet No.: PMM211105
55×18, ∅ 1 mm
5 T
CH5
CH6
Voltage, V [μV]
Applied Current, I [A]


Billet No.: PMM211105
55×18, ∅ 1 mm
5 T
CH1
CH2
CH3
CH4
CH5
CH6
d²V/dI² [nV/A²]
Applied Current, I [A]


15 T
CH5
CH6
Voltage, V [μV]
Applied Current, I [A]


15 T
CH1
CH2
CH3
CH4
CH5
CH6
d²V/dI² [nV/A²]
Applied Current, I [A]

σ/μ value is ~0.1 for PMM21105 and very close to PMM180410 (85 x18,1.0 mm) with T_{max} = 887.5 °C

Billet No.	Powder	Diameter [mm]	No. of Filaments	Filling Factor	T_{max} [°C]	t_{melt} [h]	T_c^{onset}	H_K [T]	α	J_c (5 T, 4.2 K) [A/mm^2]†
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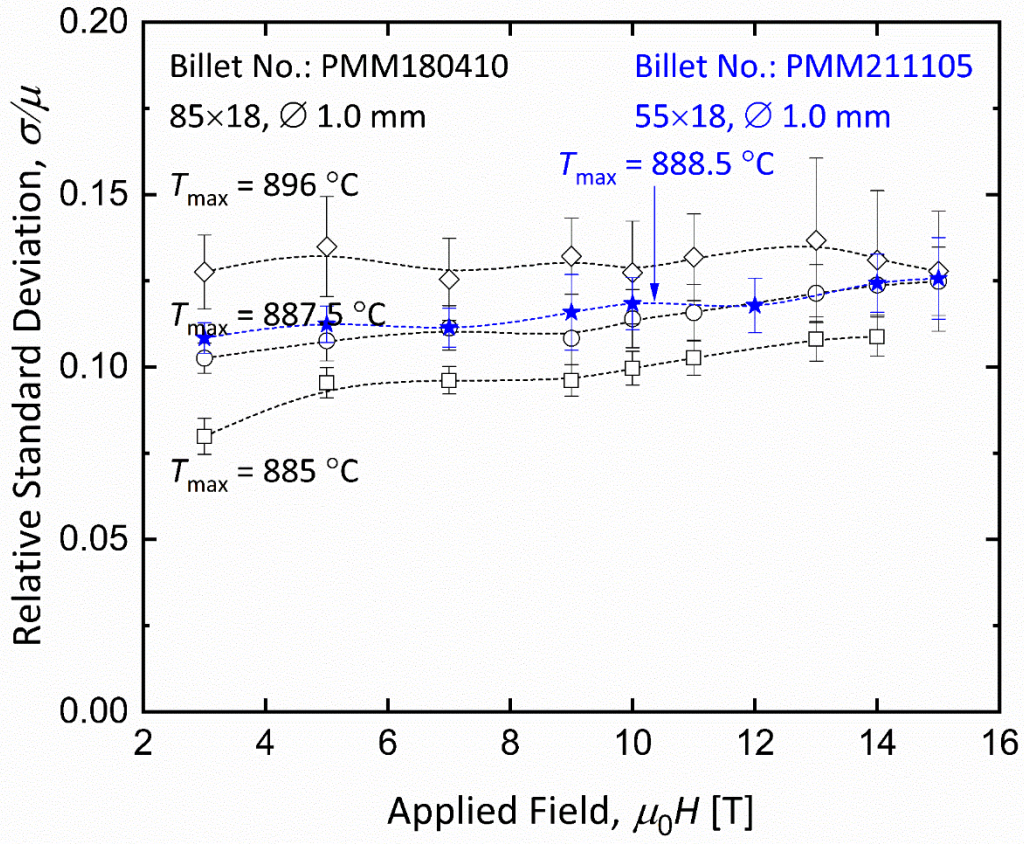
σ : Standard deviation

μ : Mean value



Shaon Barua

Barua et al., *IEEE Trans. Appl. Supercond.* 31, 6400406 (2021)

Summary

- We compared two recent CPRD billets PMM211105 (55x18) and PMM220329 (55x18) with billet PMM180627 (55x18).
  - PMM180627(55x18) has better performance
- New Engi-Mat 37x18 billet shows good performance.