



## Significantly Improved Critical Current Density in Recent Bi-2212 Round Wire

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### Introduction

Round wire Bi-2212 conductor is very promising for high field NMR and accelerator magnets because it can be made in multiple multifilament architectures and in the twisted state that benefits low hysteretic losses, isotropic properties, and high magnetic field quality. Bruker-OST is routinely producing Bi-2212 wires in multiple architectures and kilometer pieces for high field coil fabrication. Nexans was the sole commercial source for 2212 powder, but in 2015 it ceased producing powder. MetaMateria and nGimat are developing commercial sources of Bi-2212 powder in the US. We have extensively investigated Bi-2212 powders made by MetaMateria and nGimat and are doing overpressure heat treatments (OP-HT) on Bruker-OST wires made from these powders. The primary bench mark of course is the critical current density ( $J_C$ ) (and  $J_E$ ) achievable in wires made with these powders. The  $J_C$  of Bi-2212 round wires made by Bruker-OST using MetaMateria and nGimat powders are both as good as, and in some cases substantially better than,  $J_C$  in wires made with Nexans powder.

### Experimental

In order to optimize the processing conditions for these recent Bi-2212 wires fabricated by Oxford Superconducting Technology (OST) using nGimat and MetaMateria powders, we performed multiple sets of heat treatments by varying the maximum processing temperature under 50 bar at the usual 1 bar oxygen partial pressure ( $pO_2$ ). Here we report the result for one of the recent best Bi-2212 wires.

### Results

Fig. 1 shows  $J_C$  (4.2 K) as a function of applied field for 0.8 mm wire (Bruker-OST billet pmm170123) with 55x18 filaments made with nGimat powder (lot LXB-52). A new record  $J_C$  (4.2 K, 15 T) of 6860 A/mm<sup>2</sup> was achieved, an increase of 63% over previous record  $J_C$  4200 A/mm<sup>2</sup> for the wire made with Nexans powder shown in Fig. 1 and reference 1. Fig. 2 shows the transverse cross section of the fully-processed record  $J_C$  wire. Much less filament merging was observed in this record  $J_C$  wire, compared to previous wires.

### Conclusions

New record  $J_C$  for Bi-2212 round wire has been achieved. This significantly higher  $J_C$  will enhance our capability to build Bi-2212 magnet coils for the next generation of all-superconducting high-field magnets.

### Acknowledgements

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### References

[1] Jiang, J., *et al.*, IEEE Transactions on Applied Superconductivity, 27 (4), 6400104 (2017).

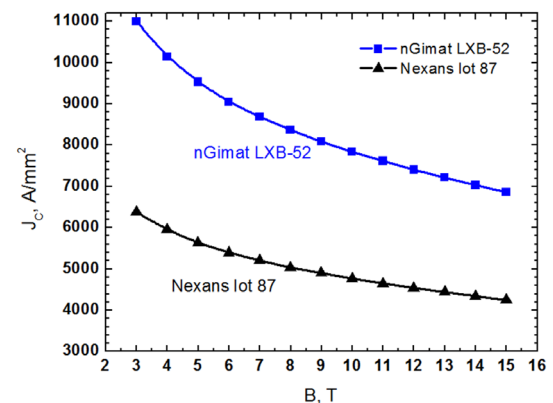


Fig.1  $J_C$  (4.2 K) as a function of applied field for the new record wire (blue) made with nGimat powder and the previous record wire (black), which was made with Nexans powder.

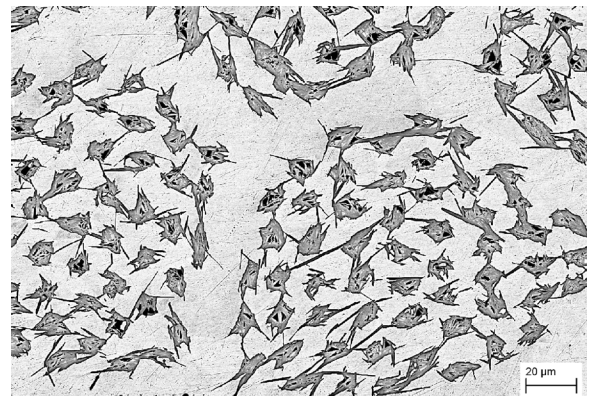


Fig. 2 SEM image of transverse cross section of the fully-processed record  $J_C$  wire made with nGimat powder.