

# Increasing the pinning force and critical currents in the YBaCuO-type superconductors

K. Rogacki<sup>1,\*</sup> and B. Dabrowski<sup>2</sup>

<sup>1</sup> Institute of Low Temperature and Structure Research,  
Polish Academy of Sciences, Wroclaw

<sup>2</sup> Institute of Physics, Polish Academy of Sciences, Warsaw  
*\*k.rogacki@intibs.pl*

We present here unique approach for generating the effective pinning centers in YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7-d</sub> (Y123) single crystals by the substitution of the Mo for Cu on the chain sites and the annealing under high oxygen pressure. We analyzed the influence of these centers on the pinning force of the vortex lines and, consequently, on the critical currents in Y123 superconductor which is the only one capable of conducting significant currents without losses at liquid nitrogen temperatures under strong magnetic fields. By using the previously obtained results on the dependence of the critical current density on the magnetic field,  $j_c(H)$ , we determined it as a function of temperature  $j_c(T)$  for different values of  $H$  and used it to resolve which pinning mechanism,  $\delta T_c$ , which is related to the spatial fluctuation of  $T_c$ , or  $\delta l$ , which takes into account fluctuations in the mean free path of charge carriers, dominates in the Y123 single crystals. [1-4] The obtained results differ both quantitatively and qualitatively from those previously reported in literature, which we explain by the distinct types of the generated pinning centers. Our results allow for a better understanding of the phenomena leading to a significant increase of the critical currents in Y123 and thus enable improved prediction of the pinning centers that operate effectively under specific/desired magnetic fields and temperatures.

## References

- [1] K. Rogacki, B. Dabrowski, O. Chmaissem, Phys. Rev. B **73**, 224518 (2006).
- [2] A. Los, B. Dabrowski, and K. Rogacki, Current Appl. Phys. **27**, 1 (2021).
- [3] K. Rogacki, A. Los, and B. Dabrowski, Low Temp. Phys. **49**, 364 (2023).
- [4] K. Rogacki and B. Dabrowski, Acta Phys. Pol. B **57**, 5-A7 (2026).