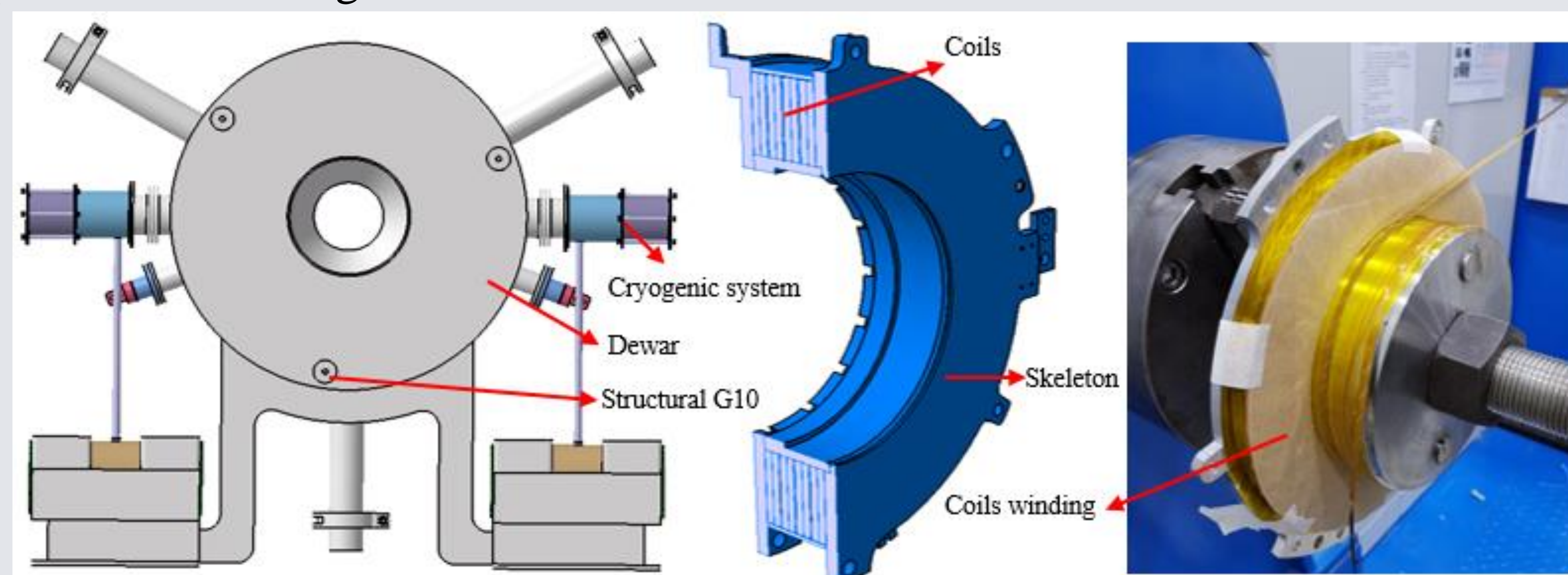


Introduction

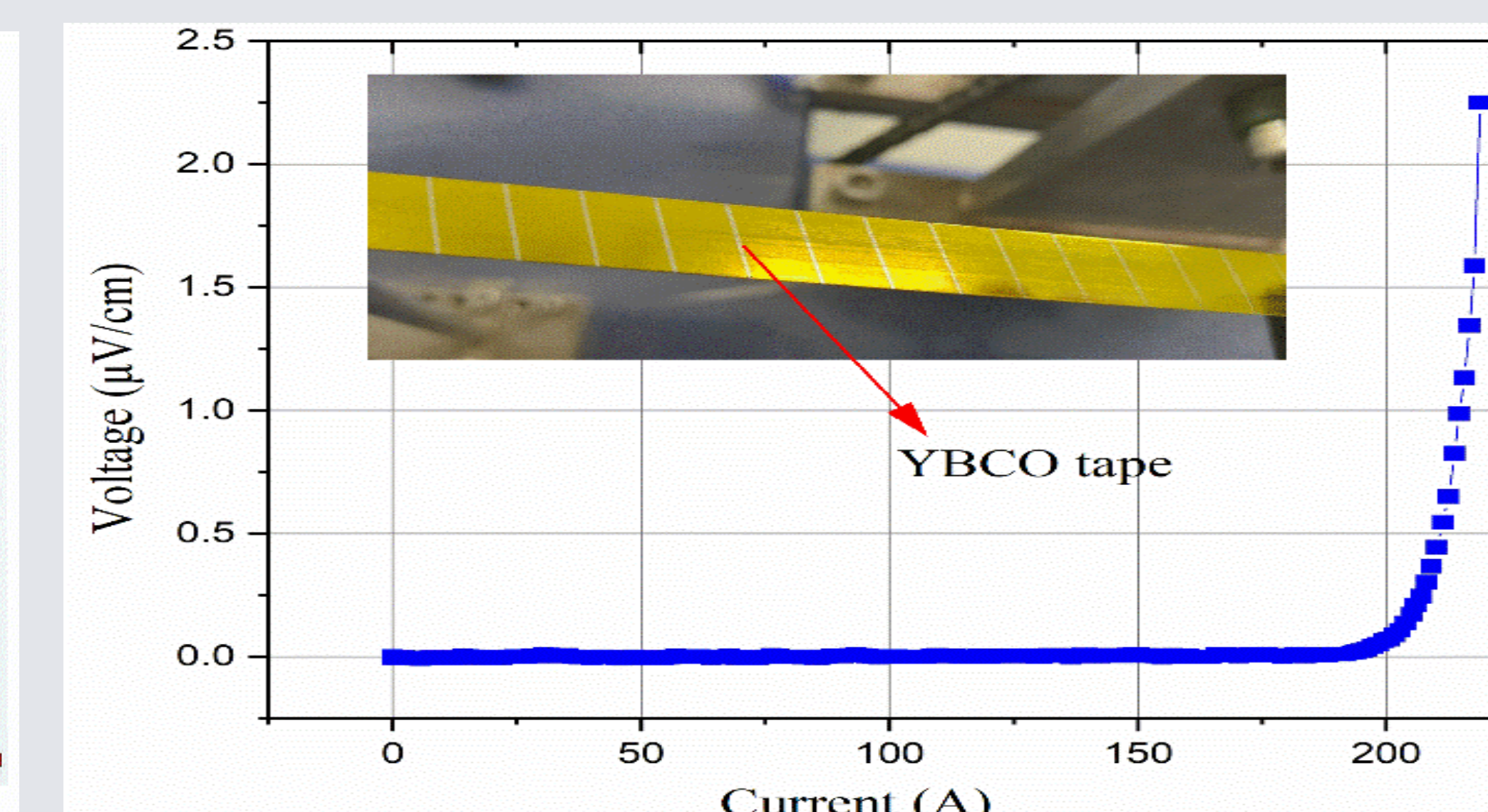
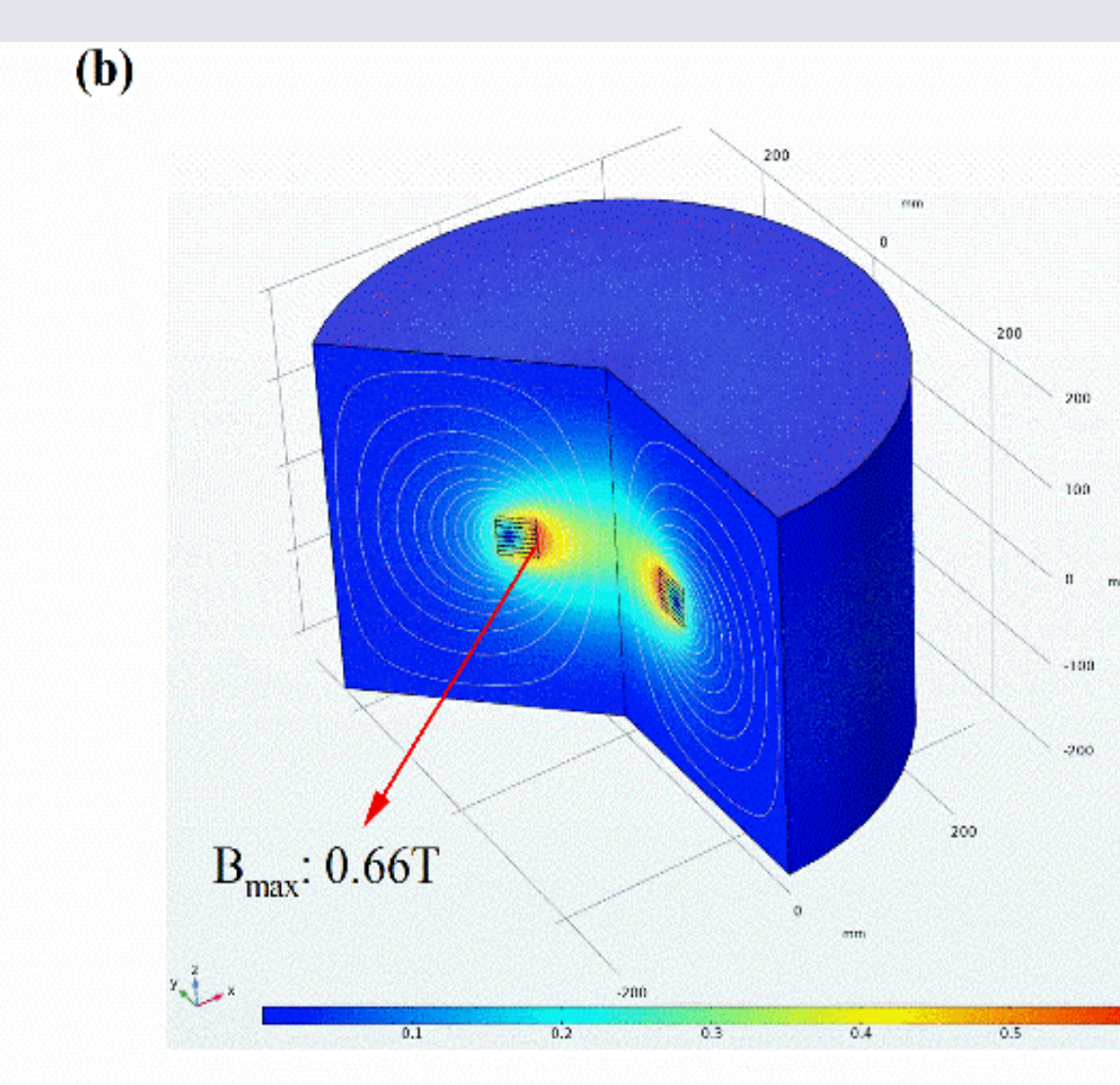
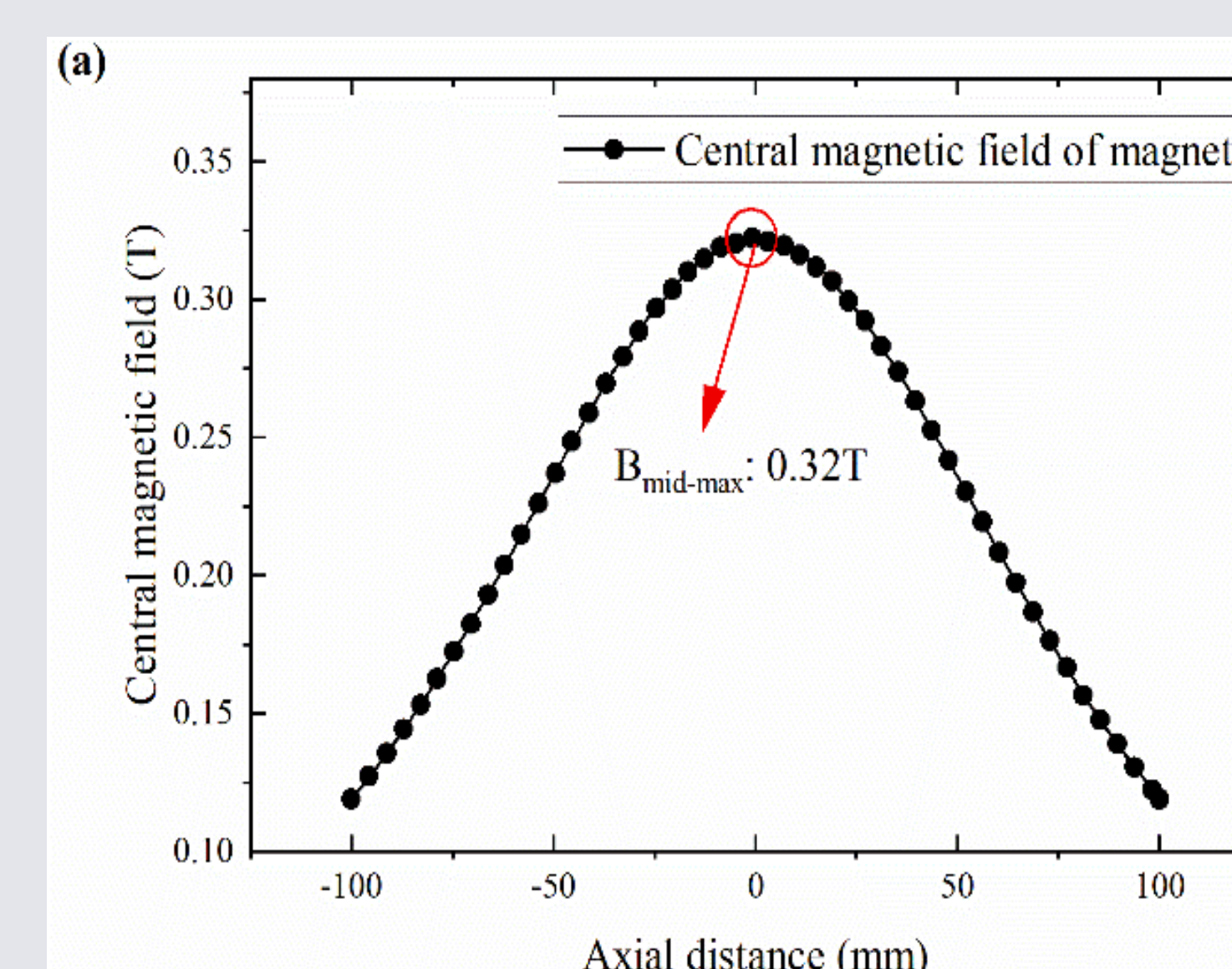
- To design a miniaturized High-Temperature superconducting magnet structure that uses Sterling conduction cooling for high-performance magnetic fields in extreme environments.
- This design aims to achieve lightweight, high current density superconducting magnets suitable for applications like magnetic levitation trains



Schematic diagram of high-temperature superconducting magnet structure.

Methods

- Miniaturized HTS magnet structure using Sterling conduction cooling
- Stability under 10-g acceleration and various magnetic fields (0.5 T, 1 T, 2 T) using T-A numerical analysis.
- Stability margin and AC losses under different conditions

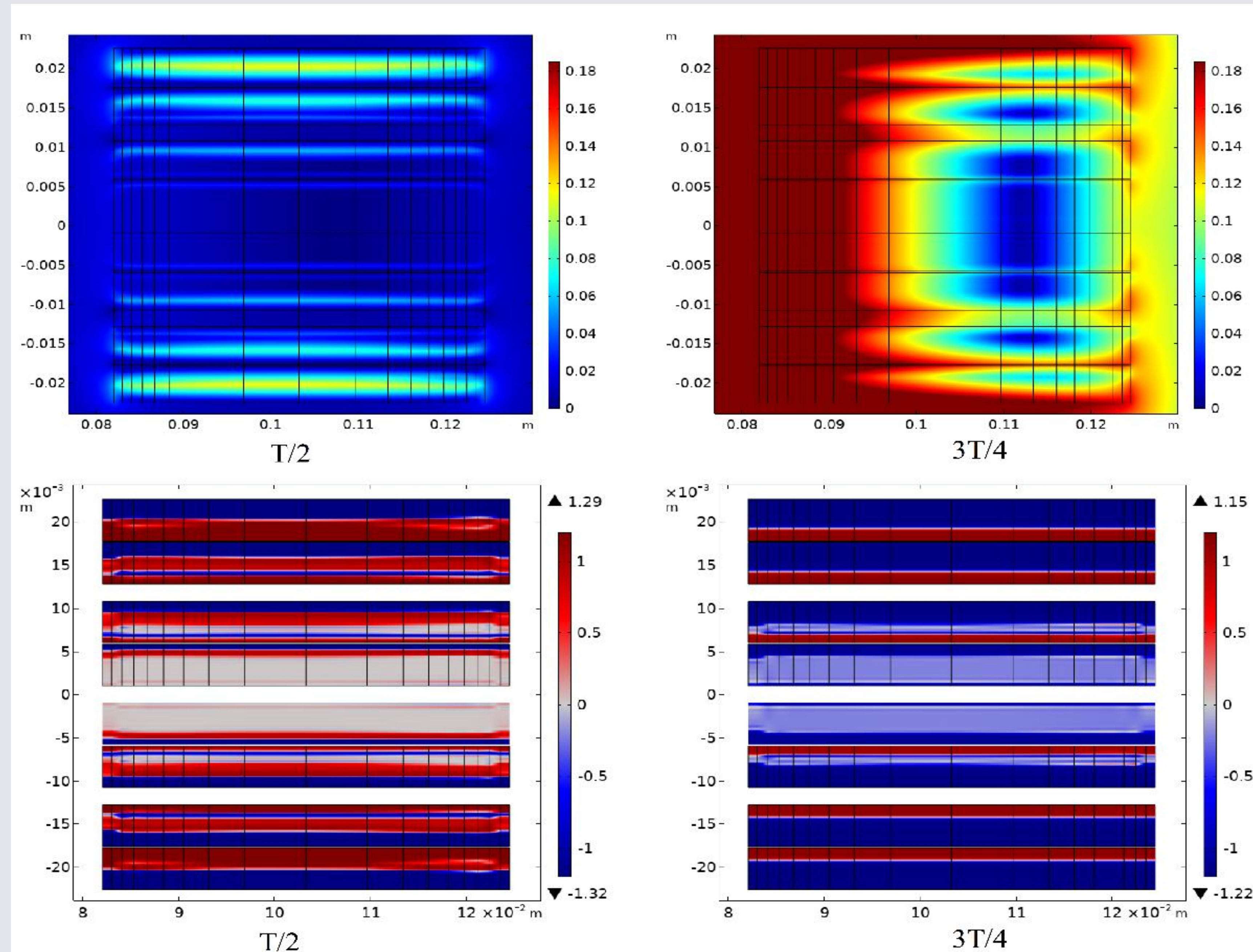


Magnetic field analysis diagram of a superconducting magnet. (a) the maximum central magnetic field; (b) the maximum magnetic field in the superconducting coil.

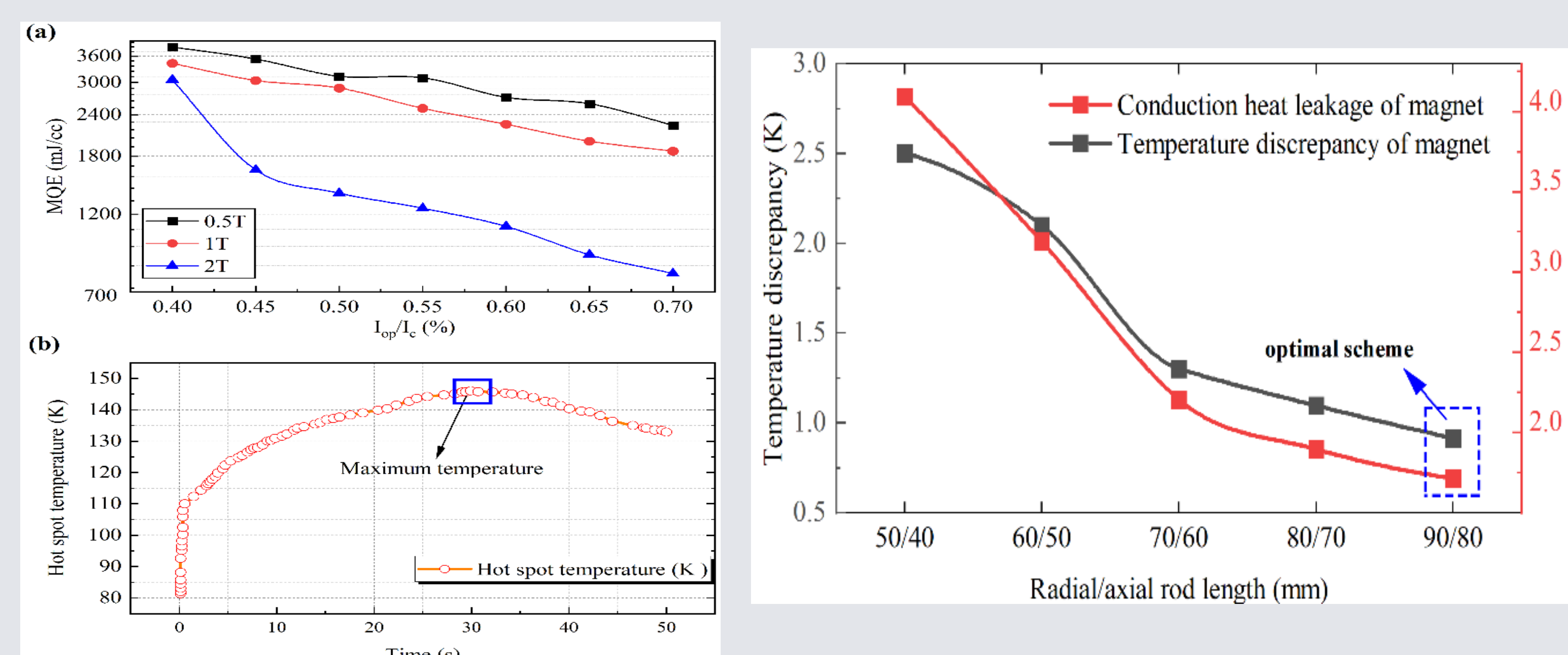
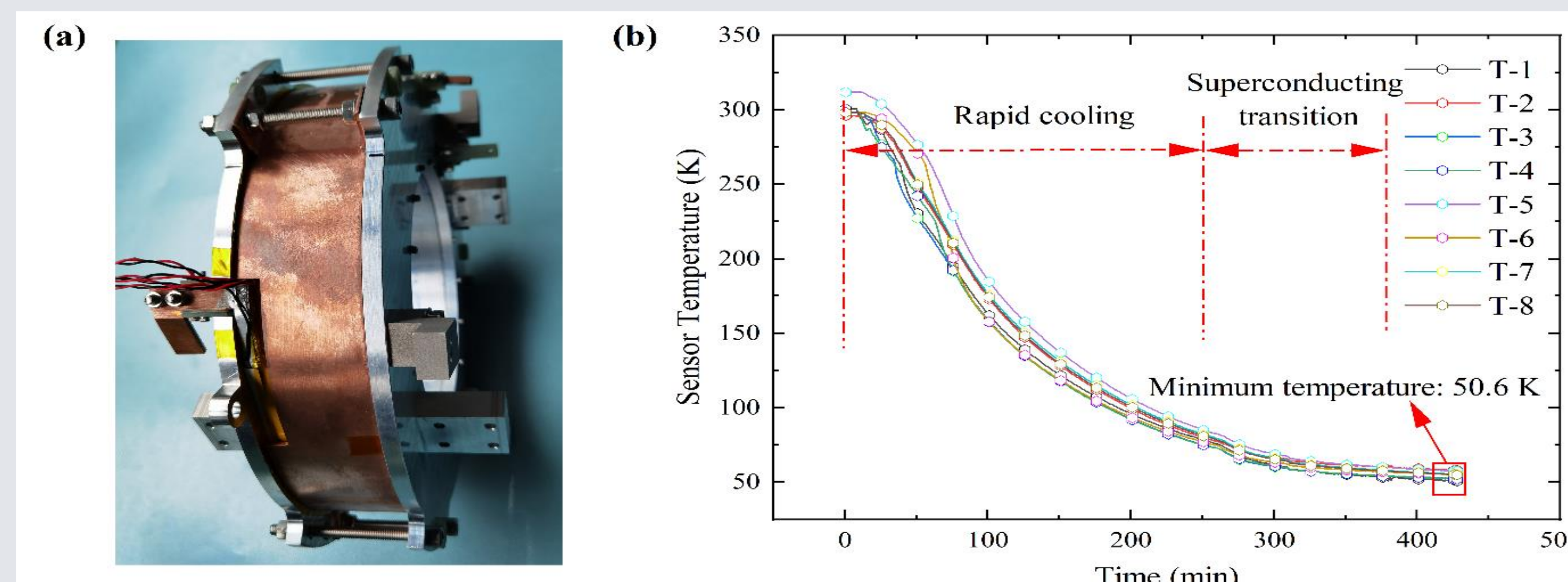
Test results of critical performance of high-temperature superconducting tape under 77 K self-field background.

Results

I. Flux penetration and current density

(Top) Flux penetration in half a period and the third quarter period
(Bottom) Current density distribution in half a period and the third quarter period

II. Stability and heat leakage

(a) Stability margin
(b) temperature change after the quench
Leakage heat and temperature discrepancy of magnet corresponding

(a) Diagram of the HTS coil and skeleton; (b) cooling process curve

III. Electrification test and structure check

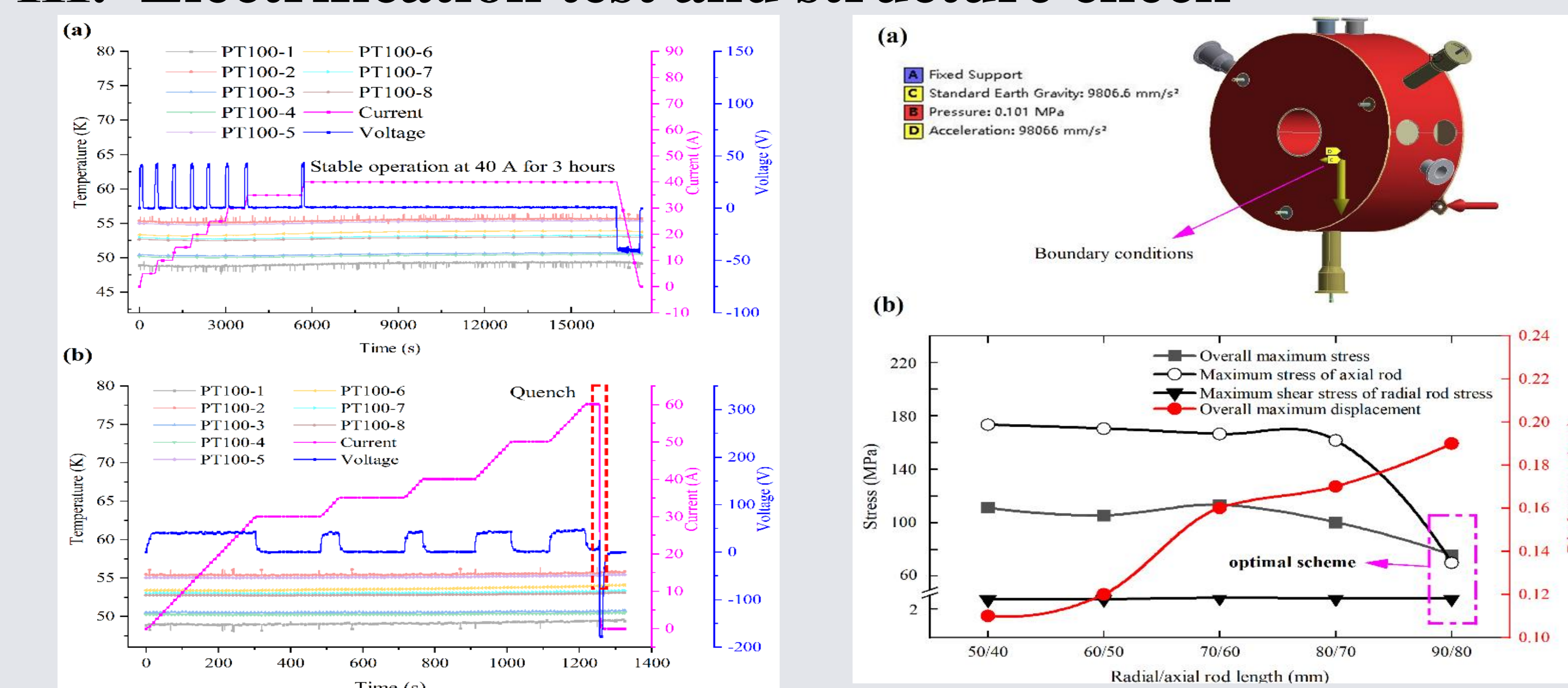
(a) excitation to 40 A
(b) excitation to 60 A
(a) boundary conditions
(b) stress calculations

TABLE: Parameters for stability analysis of superconducting magnet

Property	Value
Operating temperature	77 K
Operating current	0~60 A
Number of tapes	1
Tape's width	4 mm
The cross-sectional area of thermal component	
Copper	179.52 mm ²
Sliver	8.16 mm ²
Hastelly	81.6 mm ²
ReBCO	1.632 mm ²
Epoxy glue	27510.1 mm ²
E0	20
RRR of copper	100
Wetted perimeter	189.2 mm

References

- J. Zheng, et al., "Integrated study on the comprehensive magnetic-field configuration performance in the 150 kW superconducting magnetoplasmadynamic thruster," Sci Rep, vol. 11, no. 1, pp. 20706, Oct 19, 2021.
- S. Zou, V. Zermeno, and F. Grilli, "Influence of Parameters on the Simulation of HTS Bulks Magnetized by Pulsed Field Magnetization," IEEE Transactions on Applied Superconductivity, vol. 26, no. 4, pp. 1-5, 2016.
- H.S. Shin, et al., "The strain effect on critical current in YBCO coated conductors with different stabilizing layers," Supercond. Sci. Technol., vol. 12, no. 18, 2005.

Conclusion

- Feasibility: The proposed miniaturized conduction cooling superconducting magnet is feasible for high-speed magnetic levitation under extreme conditions.
- Future Work: Further optimization and testing in extreme conditions.