Superconductive Rings as a Way to Obtain High-Powered Magnetic Fields

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Gyrotron operates due to high magnetic fields. It is possible to generate them using a ring made from high-temperature superconductors. The main objectives of the project are developing the technology of growing and studying the properties of YBaCuO superconducting rings which could be used as a part of hybrid magnet and magnet for gyrotron. The preform was in the shape of a ring with the outer, inner diameter and height about 37mm, 19mm and 27mm accordingly was made from blend of powders Y1Ba2Cu3O7-d (100g), Y2Ba1Cu1O5 (30g) and CeO2 (1g). After putting some monocrystals of Sm1Ba2Cu3O7-d of a size about 1-2mm on the surface of the preform, crystallization was implemented. To make the ring superconducting and to improve it qualities, it was annealed in oxygen twice. Before detecting the magnetic field in the superconductive ring, it was frozen to boiling point of liquid nitrogen in the magnetic field of a solenoid which was turned off after that. Then we measured ring's magnetic field by a Hall Sensor and found out that its maximum induction was 30mT. After that we calculated its critical current density which was higher than in most of other rings created with similar technologies before. We discovered a phenomenal mismatch between theoretical ring's magnetization graph and the real one. It was figured out that superconductor magnetization can be raised by increasing period of annealing in oxygen, crystallization time, period of supercooling and strength of the external field. Using this studied technology of growing, it is possible to make a superconducting ring with larger diameter which can be used in High-Energy Physics, Plasma Technology, development the controlled thermonuclear fusion and also in transport or energy system of the future.

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