Limited liability company
«Engineering solutions»

Omsk, 644077, Prospect Mira, 55, building 2, office 216
Phone.: +7 (3812) 795-015, e-mail: info@esolut.ru

Meissner Effect, Magnetic Field Locking and Levitation Force

We present to your attention a kit for demonstrating the levitation force and magnetic field locking by a domain YBCO superconductor.

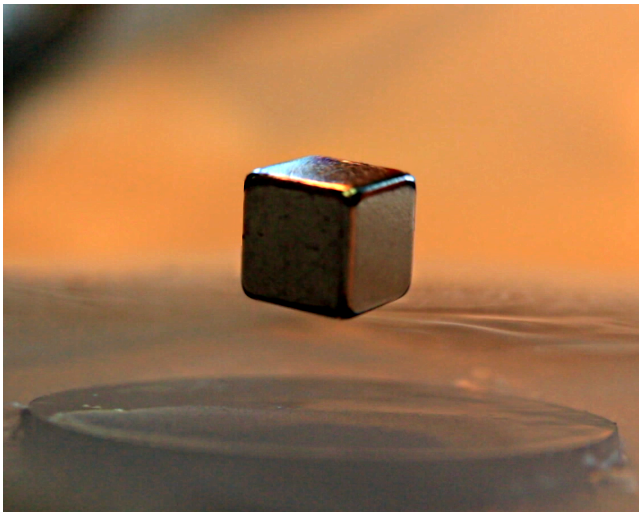

Photo Levitation

The kit includes:

- a conventional **YBCO superconductor** disk 30x5mm (for Meissner Effect) - 1pcs.
- domain superconductor disk 20x5mm (for magnetic field locking) - 1pcs.
- plastic container - 1pcs.
- small neodymium magnet 10x10x10mm - 1pcs.
- big neodymium magnet 15x15x15mm - 1pcs.
- thin spacer for distance fixation - 1pcs.
- thick spacer for distance fixation - 1pcs.
- non-magnetic tweezer - 1pcs.
- instructions with explanations. - 1pcs.

Photo of the kit contents

To demonstrate the effects, you need to purchase **liquid nitrogen** in your region.

What are superconductors?

Superconductors are materials that satisfy two criteria:

1) the electrical resistance in the superconductor is zero;

2) the magnetic field inside the superconductor is zero - the superconductor is an ideal diamagnet.

Demonstration of the Meissner Effect (a simple YBCO superconductor).

The Meissner effect is that a constant magnetic field is pushed out of a superconductor. Since the magnetic field inside the superconductor is zero, there must be a source of the opposite magnetic field. This source is the superconducting current. Because of the perfect diamagnetism, a magnet can levitate above a superconductor.

1. Place a simple superconductor in the center of the container for cooling.
2. Fill with liquid nitrogen and wait for the superconductor to cool (nitrogen will stop boiling)
3. Take a small magnet and try to suspend it above the superconductor. Since the system may be unstable on the first try, we recommend pressing the magnet slightly against the superconductor.
4. The magnet levitates above the superconductor. Here, there is a repulsive force between the superconductor and the magnet.
5. Try pressing a magnet against the surface of a simple **YBCO superconductor** and observe the insignificance of the repulsive force. (Note: There is also a **domain**

<u>superconducting ceramic</u> that can demonstrate "**<u>quantum locking</u>** and **<u>levitation force power</u>**")

Demonstration of Magnetic Field Locking And Power Levitation Force (Domain superconductor).

The capture of a magnetic field occurs in a domain superconductor when it is cooled in a magnetic field. If an attempt is made to change the magnetic field, a current will be generated in the domain superconductor that prevents this change.

Photo of a domain superconductor hanging under a magnet

1. Put the domain superconductor in the center of the container for cooling.
2. Place the spacer on the domain superconductor, and then place the neodymium magnet on it.
3. Pour liquid nitrogen and wait for the entire superconductor to cool.
4. Remove the spacer from under the magnet.
5. The magnet levitates above the domain superconductor at a distance equal to the thickness of the spacer.
6. Try pulling the domain superconductor out of the liquid nitrogen by pulling on the magnet. The superconductor is held at a fixed distance from the magnet without approaching or moving away.
7. Try pressing the magnet to the surface of the domain superconductor and feel the power of the repulsive force. <u>!!!The repulsive force on a simple YBCO superconductor is very small!!!</u>
8. If you use a thin spacer, you can freeze a significantly larger magnetic field. To do this, you need to perform steps 1-4.
9. By pulling the domain superconductor out of the liquid nitrogen with the magnet, you can see that it is stably captured by the magnet no matter how you turn it. <u>!!!This effect is absent on a simple superconductor!!!</u>

10. The domain superconductor taken out of the liquid nitrogen heats up after a while, so we recommend cooling it approximately once every 10 seconds by immersing it in liquid nitrogen.

Additional information.

High-temperature superconducting ceramic YBCO is a material consisting of small crystallites sintered together into a single product.

In simple superconducting ceramics ($YBa_2Cu_3O_{7-x}$), all crystallites are superconducting, have the same composition, and are also randomly distributed throughout the volume, due to which only the Meissner effect is observed in it and there is no **quantum locking** effect.

Domain superconducting ceramics ($Y_{1.8}Ba_{2.4}Cu_{3.4}O_{7-x}$) consists of crystallites of different composition, both superconducting and not, in addition, in such ceramics, all crystallites are ordered in a certain way in one direction (forming a domain), which creates an additional **magnetic field trapping effect** (“**quantum locking**”) and significantly enhances the **levitation force**.