German utility model no. DE202024100204U1

High-Temperature Superconductivity through Multiplication of Interface Effects

Description

High-temperature superconductors have been known for a long time and exhibit no significant electrical resistance below the critical temperature. In addition to increasing the critical temperature by combining various materials with environmental variables, there are also other advances in research, such as a superconducting diode.

Many materials exist that conduct electrical currents without resistance due to quantum mechanical effects at edges, interfaces, or surfaces (e.g., topological insulators, T. Patlatiuk et al. 2018). Similar effects also occur at low temperatures and in "two-dimensional metals" with strong magnetic fields. Topological insulators are of interest for electronic components, among other applications. However, this invention primarily focuses on superconductivity through the tunneling effect. According to quantum mechanics, the tunneling effect can result in tunnel currents even in non-conductive materials when the distance is extremely small (e.g., quantum Hall effect, quantum Hall systems, quantum spin Hall effect).

Tunnel currents can be explained by currents in higher dimensions, which are also essential in string theories (M-theory, etc.). These additional "smallest" and interconnected dimensions can explain tunnel currents along with other "quirky" effects.

The goal is to achieve superconductivity at ambient or room temperature for many everyday and industrial applications. These can include power lines, energy generation and storage, data processing in hardware, and (very strong) magnetic fields.

Background of the Invention

My invention is based on the further development of superconductors. There are many solutions related to this invention, such as:

- DE000003739258A1: High-temperature superconductivity starting at 77K, production, and use.
- DE000060121310T2: Palladium hydride high-temperature superconductor.
- DE102008016258B3: High-temperature superconductor, layer arrangement, and production.
- EP000004287281A1: Low-resistance electron transport in solids.
- US020060052250A1: High-temperature superconductor, production, and use.
- WO002018198121A1: Quantum Hall edge device.

The existing solutions fulfill their respective functions (or are still in development) but do not have the capabilities of the above-mentioned invention.

A universally applicable solution is desired. The invention specified in claim 1 for high-temperature superconductivity through the multiplication of interface effects with extreme enlargement of edge, surface, and/or interface areas, thus enabling current conduction without electrical resistance, meets these requirements.

Example of Implementation

Superconductivity is exemplified here by the quantum Hall effect. However, according to claim 2, it can be extended to all situations where tunnel currents are present.

When the quantum Hall effect occurs (e.g., in topological insulators), current flows only at the interfaces/edges. As shown in claim 3, these edge currents are used for the superconductor by making the superconducting part consist of many edges, interfaces, and/or very large surfaces. Thus, the thinnest/fine quantum Hall systems together form a "large" overall superconductor. This is made possible (according to claim 4) by a construction such as a small roll with extremely thin layers (Fig. 1). The rolled-up structure thus becomes a superconducting wire in length and represents a cross-section that can have a very different diameter depending on requirements.

As shown in claim 5, a similarly large surface/edge or interface structure in cross-section can also be achieved with a small square or cuboid consisting of many layers (Fig. 2), which can also be rolled up. In length, the device thus becomes a square superconducting wire or a significantly larger component. Other shapes are, of course, also possible.

By connecting the superconducting sections ("in series" and/or "in parallel"), the effectiveness/maximum load capacity, etc., is correspondingly increased according to claim 6.

As illustrated in claim 7, the superconductors are designed and isolated according to requirements (outside and, if necessary, within the construction). This means that in addition to standard forms such as wire or cuboid, all geometric shapes are possible as long as superconductivity is achieved.

Various materials and their combinations/alloys/with different mixtures/proportions with edge and interface effects can be used for the superconductor (according to claim 8): for example, from different groups of the periodic table, such as rare earths, metals, transition metals, but also plastics, etc.

As shown in claim 9, inside and/or outside the superconductor or the overall construction, a support device can be useful, which can be made of metal, plastic, or other materials.

The surfaces/edge structures/interfaces can be enlarged by additional porosity (similar to natural or synthetic zeolites) (according to claim 10).

As described in claim 11, as outlined in publications, the tunnel currents are influenced by magnetic fields and/or in a vacuum, and the electrons are "further conducted" (possibly also without magnetic fields). The optimal combination of tunnel currents, magnetic fields, vacuum, etc., must be determined depending on the design and application.

Reference

T. Patlatiuk, C. P. Scheller, D. Hill, Y. Tserkovnyak, G. Barak, A. Yacoby, L. N. Pfeiffer, K. W. West & D. M. Zumbühl: *Evolution of the quantum Hall bulk spectrum into chiral edge states*, Nature Communications 9, Article number: 3692 (2018)

Reference List

(1) Superconductor
(2) Support structure
(3) Insulation

Claims

1. High-temperature superconductivity through multiplication of interface effects,
characterized in that
the devices have an extreme enlargement of edge, surface, and/or interface areas.

2. High-temperature superconductivity through multiplication of interface effects, according to claim 1,
characterized in that
devices are built for all situations where tunnel currents are present and can be utilized.

3. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
superconductors are constructed that consist of, for example, the thinnest/fine quantum Hall systems and form a "large" overall superconductor.

4. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
the superconductor is built, for example, in the form of a small roll with extremely thin layers (Fig. 1). The rolled-up structure thus becomes a superconducting wire in length, which can have a very different diameter.

5. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
the superconductor has the shape of a small square or cuboid in cross-section, consisting of many layers (Fig. 2), which can also be rolled up. In length, the component thus becomes a square superconducting wire or a significantly larger component. Other shapes are also possible.

6. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,

characterized in that
individual superconductors (or the superconducting sections) are interconnected ("in series" and/or "in parallel").

7. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
the superconductors are isolated according to requirements (outside and, if necessary, within the construction).

8. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
different materials and their combinations/alloys/with different mixtures/proportions with edge and interface effects are used for the superconductor: e.g., from different groups of the periodic table, such as rare earths, metals, transition metals, but also plastics, etc.

9. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
a support device is constructed inside and/or outside the superconductor or the overall construction, which can consist of metal, plastic, or other materials.

10. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
the surfaces/edge structures/interfaces of the superconductor are enlarged by additional porosity (similar to natural or synthetic zeolites).

11. High-temperature superconductivity through multiplication of interface effects, according to one of the preceding claims,
characterized in that
the tunnel currents/superconducting currents are influenced by magnetic fields and/or in a vacuum, and the electrons are "further conducted" (possibly also without magnetic fields).

Depending on the application and design, an optimal combination of tunnel currents, magnetic fields, vacuum, etc., is determined.

Fig.1

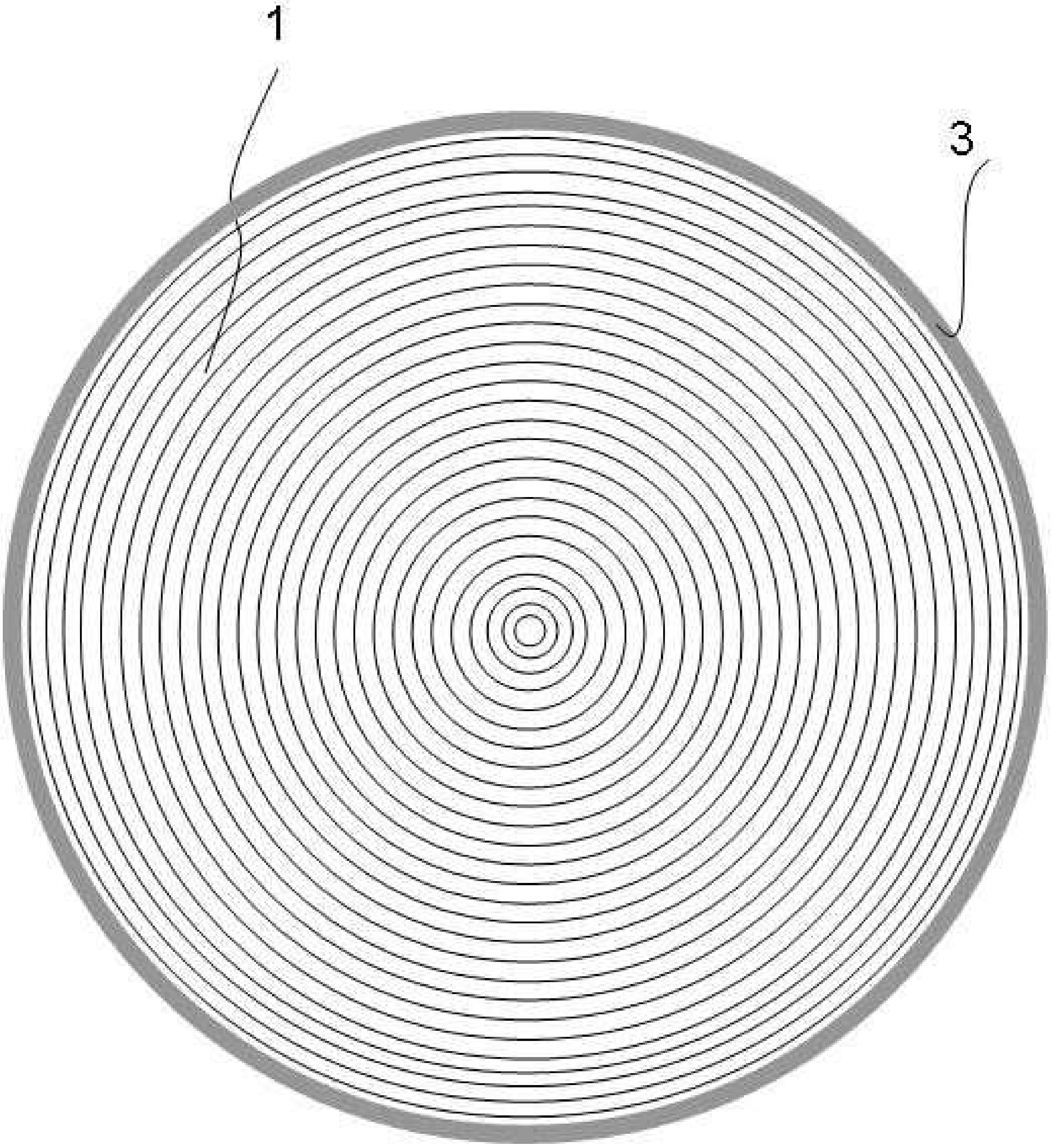

Fig. 2