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Mechanical properties of bulk MgB2 superconductors processed by spark plasma sintering at various temperatures

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Superconducting bulk materials have high trapped magnetic field ability at a temperature lower than the critical temperature. Since superconducting bulk materials are subjected to electromagnetic force during magnetization process, improvements of the mechanical properties are indispensable for the development of high performance bulk materials. However, the mechanical properties of conventional MgB2 superconducting bulk materials are inferior to those of rare-earth based superconducting bulk materials, which is mainly due to the lower packing ratio. In this study, high packing ratio MgB2 bulk materials are obtained through spark plasma sintering SPS at various temperatures: 1223, 1273 and 1373 K. Effects of the SPS temperature on the mechanical properties of the MgB2 bulk materials are investigated through bending tests of specimens cut from the bulk materials. Both the Young's modulus and bending strength are improved by the increase of SPS temperature. It is deduced that the improvements of the mechanical properties are mainly due to the improvement of the packing ratio. Relationship between the bending strength and packing ratio of the spark plasma sintered MgB2 bulk materials can be approximated by using an exponential equation. The approximation curve is similar to that obtained from the data of MgB2 bulk materials fabricated by other sintering methods such as capsule method and hot isostatic pressing in the previous study.

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