Magnetic properties of large-scaled MnBi bulk magnets

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The high performance MnBi bulk magnet has been required for real applications of hybrid and electric vehicles since the low-temperature-phase (LTP)-MnBi has been attracted much attention as a good candidate for high temperature applications. Much work has reported in MnBi powders because there was a problem to overcome the difficulty of LTP formation. The magnetic properties of bulk magnets are strongly dependent on the details of the synthesis process and should be measured from large-scaled samples. However, the reported values of $(BH)_{max}$ of MnBi bulk magnets were obtained from only a part of an original bulk sample using a vibrating sample magnetometer (VSM) or a superconducting quantum interference device magnetometer (SQUID). In particular, $(BH)_{max}$ of bulk magnets obtained by VSM, MPMS, and PPMS can be misled or overestimated due to different sample preparations from that for a *B-H* loop tracer. It is well known that the *B-H* loop tracer is a general and reliable apparatus for measuring the magnetic properties of large-scaled bulk hard magnets. In this paper, we investigated the magnetic properties of large, compacted, sintered MnBi bulk magnets with dimensions of 20.3×15.3×10.3 mm^3. We have tried a new procedure for the preparation of high-quality precursor powder to attain high LTP content: melt-spinning, cold-pressing, annealing, magnetic separation, and grinding. By adopting the new process, the amount of LTP obtained was ~98 wt%, which is the highest value compared to that presented in the literature for precursor powders. The improvement of coercivity was accomplished by controlling the particle size using different milling techniques. The magnetic properties of the hot-compacted MnBi bulk magnets were investigated using the entire as-prepared bulk sample without cutting. The highest maximum energy product, $(BH)_{max}$, obtained among our samples was 7.3 MGOe. This is the first report of demonstrating high performance in large-sized MnBi bulk magnets. Our results show that our process can yield high-performance in MnBi bulk magnets with larger dimensions

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