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Heat demagnetization of combined Nd–Fe–B/Sm–Co magnet

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A Sm–Co/Nd–Fe–B/Nd–Fe–B/Sm–Co assembly consisting of 16×8×6 mm^3 size magnets magnetized parallel to the 6 mm edges with the upper operating temperature limits T_e = 200 to 220°C (Sm–Co) and T_e≈100°C (Nd–Fe–B) has been found to have T_e≈160°C. The thermal demagnetization of an assembly of four Nd–Fe–B magnets occurs mainly due to that of outer magnets. Temperature and time dependences of magnetic flow have been measured for individual magnets as well for assemblies of different heights inside and outside of a magnetic system. The magnetic flow degradation under heating decreases as the magnet height increases and is lesser in a closed magnetic system.

Экспериментально установлено, что сборка Sm–Co/Nd–Fe–B/Nd–Fe–B/Sm–Co из магнитов с размерами 16×8×6 мм^3, намагниченных параллельно ребру 6 мм, с верхним пределом рабочей температуры T_e (Sm–Co) = 200. ..220°C и T_e (Nd–Fe–B)≈100°C имеет T_e≈160°C. Тепловое размагничивание сборки из 4-х магнитов Nd–Fe–B происходит в основном за счёт размагничивания краевых магнитов. Построены температурные и временные зависимости магнитного потока отдельных магнитов и сборок разной высоты в магнитной системе и вне её. Деградация магнитного потока при нагреве магнита снижается с увеличением высоты магнита и менее заметна в магнитной системе.

Rare-earth magnets stand out against other known magnets due to their high specific magnetic energy combined with a high coercive force [1, 2]. The Nd–Fe–B magnets and Sm–Co ones, being similar to each another in magnetic characteristics, differ appreciably in the upper operating temperature limit, T_e: for Nd–Fe–B, T_e amounts 100 to 150°C while for Sm–Co, 200 to 220°C. Furthermore, Sm–Co magnets are about twice so expensive as Nd–Fe–B ones [3, 4]. For some applications, however, it is reasonable to have a magnet with a T_e value intermediate between the above-mentioned characteristics and cheaper than Sm–Co one. In this connection, it is of interest to study the heat demagnetization of magnets assembled of Nd–Fe–B and Sm–Co elements. This is just the question that this work is aimed at.

The magnets of 16×8×6 mm^3 size and the magnetization direction to the 6 mm edges made from Nd–Fe–B and Sm–Co alloys grades, respectively. The magnetic flow was measured using a M119 microwebermeter with a coil of 50 mm in dia. The magnet to be studied was placed into the coil, the magnetization direction being parallel to the coil axis. The measurements were made prior to and after the magnet heating (in the latter case, the magnet was cooled down to RT prior to measurement). Then the magnet was magnetized again up to saturation and heated up to a new temperature value. For heating, a magnet or a magnet assembly was placed into a heated tubular