

## Magnetic flow of combined Al-Ni-Co-Fe/Nd-Fe-B magnet

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Dependence of the magnetic flow in combined Nd-Fe-B/Al-Ni-Co-Fe/ Nd-Fe-B magnet on the fraction  $\eta$  of Nd-Fe-B magnets has been studied in experiment. The coefficient  $k = (\Phi - 2\Phi(\text{Nd-Fe-B})) / \Phi(\text{Al-Ni-Co-Fe})$  where  $\Phi$ ,  $\Phi(\text{Nd-Fe-B})$ , and  $\Phi(\text{Al-Ni-Co-Fe})$  denote the magnetic flows of the assembly, Nd-Fe-B, and Al-Ni-Co-Fe magnets, respectively, has been proposed to characterize the influence of Nd-Fe-B magnets on the Al-Ni-Co-Fe magnetic flow. The  $k$  value has been found to depend both on  $\eta$  and on the Al-Ni-Co-Fe magnet size. The  $k$  value increases with the magnet cross-section while decreases as the Al-Ni-Co-Fe magnet height rises. The flow of a  $40 \times 37 \times 9 \text{ mm}^3$  Al-Ni-Co-Fe magnet interposed between Nd-Fe-B ones at  $\eta \geq 55\%$  (vol.) exceeds that of the free Al-Ni-Co-Fe magnet by a factor of almost 5. The temperature dependence of magnetic flow has been determined for the assembly. The assembly heat stability has been found to be defined by that of the Nd-Fe-B magnets.

Экспериментально изучена зависимость магнитного потока комбинированного магнита Nd-Fe-B/ Al-Ni-Co-Fe/Nd-Fe-B от доли  $\eta$  Nd-Fe-B магнитов. Для характеристики влияния Nd-Fe-B-магнитов на магнитный поток Al-Ni-Co-Fe-магнита введен коэффициент  $k = (\Phi - 2\Phi(\text{Nd-Fe-B})) / \Phi(\text{Al-Ni-Co-Fe})$ , где  $\Phi$ ,  $\Phi(\text{Nd-Fe-B})$  и  $\Phi(\text{Al-Ni-Co-Fe})$  — магнитные потоки, соответственно, сборки, Nd-Fe-B- и Al-Ni-Co-Fe-магнита. Установлено, что  $k$  зависит как от  $\eta$ , так и от размеров Al-Ni-Co-Fe-магнита. Значение  $k$  увеличивается с увеличением размеров магнита в плане и уменьшается с увеличением высоты Al-Ni-Co-Fe-магнита. Показано, что поток Al-Ni-Co-Fe-магнита с размерами  $40 \times 37 \times 9 \text{ мм}^3$ , находящегося между Nd-Fe-B-магнитами, при  $\eta \geq 55 \text{ об.}\%$  почти в 5 раз больше потока этого магнита в свободном состоянии. Построена температурная зависимость магнитного потока сборки. Установлено, что термостабильность сборки определяется термостабильностью Nd-Fe-B-магнитов.

Properties of a magnet are known to be defined not only by its material but also by other factors, including the magnet dimensions, as well as by the peculiarities of the magnet system where the magnet is included [1, 2]. There are data on the properties of a Sm-Co/ Nd-Fe-B/Sm-Co magnet assembly consisting of magnets with the working temperature upper limit  $T_e(\text{Nd-Fe-B}) = 100^\circ\text{C}$  and  $T_e(\text{Sm-Co}) = 200$  to  $220^\circ\text{C}$ . The

outer Sm-Co magnets having higher working temperature limit as compared to the inner Nd-Fe-B ones inhibit the thermal demagnetization of the latter. As a result, the  $T_e$  value for the magnet assembly exceeds  $160^\circ\text{C}$ . The temperature dependence of magnetic flow for the magnet assembly is less steep than that for Nd-Fe-B magnet [3].

The materials Nd-Fe-B and Sm-Co used to construct the above-mentioned combined