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TECHNOLOGY OFFER

Nd-Fe-B permanent magnets with up to 30 % higher coercivity

Nd-Fe-B permanent magnets, which are exposed to the electrophoretic deposition of heavy rare earth (HRE) fluoride powder and subsequent grain-boundary diffusion process (GBDP) achieve up to 30 % higher coercivity, compared to the uncoated magnets. At the same time, the used amount of precious HREs is up to 10-times lower, compared to the magnets, processed only by the powder metallurgy route.

Technology field: Nd-Fe-B permanent magnets.

The problem:
The incresased use of Nd-Fe-B magnets in the motors of electrical vehicles is hampered by their relatively poor high temperature performance, characterised by unsufficient coercivity. In such automotive applications it is necessary for the magnets to operate for long periods at temperatures up to 150 °C. Any rare earth transition-metal magnet enables development of sufficient coercivity at high temperature by improving the intrinsic temperature dependence of the material. Unfortunately, the intrinsic properties of Nd-Fe-B are very difficult to change. Therefore other approach is needed. For developing coercivity at high temperatures, the development of higher coercivity at room temperature is also an option, so that enough coercivity remains when the magnet is exposed to increased temperatures. Usually it is done by adding of HREs using the grain-boundary diffusion process, initiated with:
-the dip-coating in the HRE-suspension, which is uneven,
-the three dimensional sputtering, which is extremely expensive,

The solution:
The problem of coating can be solved with the electrophoretic deposition of the HRE-powder. This is a fast method (tens of seconds), reliable and cost effective process, which is beneficial especially for the industrial usage.

Advantages

The HRE coating method is accurate, thickness controlable and fast.
The overall HRE content after the process is in range of 0.6 wt.%.
Mass production is possible.

Low operating and maintenance costs.

With electrophoretic deposition, with controlled applied voltage and deposition time, smooth and evenly distributed coatings are formed, as shown in Figure 1.

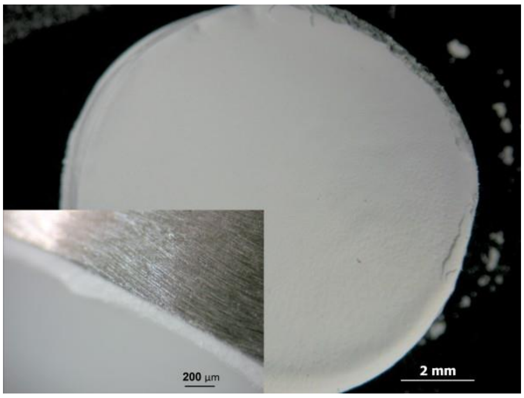

Figure 1: Evenly coated surface of Nd-Fe-B magnet with the HRE-coating, using the electrophoretic deposition.

The demagnetization curves were measured at room temperature and the results are shown below in Figure 2. The coercivity was improved for around 30 %, while the remanence was slightly reduced. The direct positive effect can be observed from the demagnetization curves.

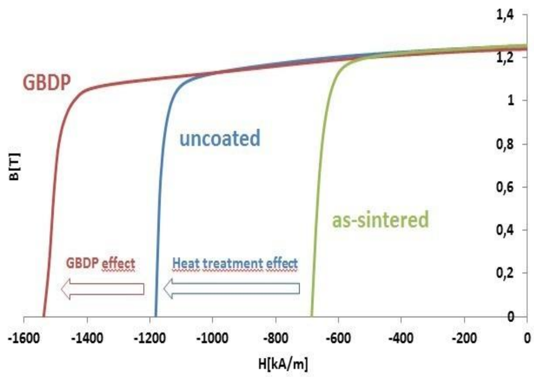

Figure 2: The demagnetization curves of the magnet treated with our technology (blue) and referenced magnet (green)

The important issue is the final amount of HRE in the magnet. Using this technology the amount of HRE in the magnet was measured to be 0.6 wt %, which can make magnet production cost-effective.

Stage of development

The technology has been demonstrated and tested in laboratory. Technology is ready to be licenced out.

Target sectors for commercialization/applications

Producers of permanent magnets.

Intellectual property

Know how.

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