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NEW PROCESSING OF RE-BASED MAGNETIC MATERIALS

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Rare-earth transition metals permanent magnets are vital components in the rapidly-developing renewable energy sector, where the motors require strong magnets with the ability to operate at temperatures well over 100 °C. To achieve high coercivity, remanence and consequently high energy product at elevated temperatures, the addition of heavy rare earth (HRE) to the basic Nd-Fe-B composition is needed. On the list of critical raw materials published by the EC in 2014, HRE is on the very top of it. To drastically reduce the use of HRE, we focused on developing a new method, which should enable us to achieve the properties needed for high-temperature application with the lowest amount of scarce elements. With our new inventive technique, further transferred to pilot production, we could minimize the amount of HRE used, down to 0.2 at %, the improvement of coercivity was 30 % with minimal loss in remanence. The total saving of the HRE is 16-times less need of HRE for the same performance, which is a significant contribution to the world economy and clean environment. In studying the mechanism for such an improvement in coercivity without significantly decreasing the remanence, a detailed microstructure investigation was performed by using high-resolution transmission electron microscopy. The so-called core-shell grains were observed, the thickness of the shell varied from 150 to 200 nm. By using the electron holography imaging, we also observe the magnetic domains. Reconstructed phase showed the magnetic flux distribution and colour maps. The contour spacing was π/2. Besides the use of these newly developed high energy magnets for electric and hybrid cars and the wind turbine generators the important application is also as the source of the magnetic field in the development of the new magnetic cooling devices.

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