Recycling rare-earth metals from motor magnets for electric vehicles

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The spread of electric vehicles is desired as an initiative toward carbon neutrality. In a step towards this proposition, Rare Earth Elements, REEs recovery technology that can reduce work time by 50% by simplifying the process without disassembling the motor of an electric vehicle or demagnetization of the magnets using the pyrometallurgical process, which is based on thermodynamic properties and phase diagrams at high temperature, was established by an industry-academia collaboration between Waseda University and Nissan Motor Co. Ltd.

First, the rotor of an EV motor containing a neodymium magnet that has not been heat-demagnetized is melted with a carbonizing material at approximately 1,400 ° C. Next, iron oxide is added to selectively convert REE in the magnet to a REE oxide such as Nd_2O_3. The melting point of the REE oxide is extremely high, as represented by the melting point of Nd_2O_3 at 2,270 °C. Therefore, $Na_2B_4O_7$ flux is added to lower the melting point of the REE oxide to produce the molten $Na_2B_4O_7$-RE_xO_y slag (RE: Nd, Pr, Dy, Tb) . Iron, which is the main component of the rotors and neodymium magnets, reacts with the carbonizing material to form the liquid Fe-C alloy. The slag has a lower density than the molten Fe-C alloy, hence, it is separated into the upper part of the alloy in the vertical direction owing to the difference in density, and the separated $Na_2B_4O_7$-RE_xO_y slag is recovered from the furnace. The $Na_2B_4O_7$-RE_xO_y slag is recovered as a high-purity REE complex oxide by applying the hydrometallurgical treatment of the current method.