High Clarke number element based new permanent magnetic materials

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With the advent of high performance permanent magnets based on the rare earth elements such as Sm-Co, Nd-Fe-B alloys in the 1980s, the application areas have been extended from the electronics to hybrid electric vehicles and wind turbines etc. However, the advantages of these rare-earth element based magnets may be overshadowed by the supply constraints, high prices and environmental issues.

Therefore, many researchers have paid much attention on the non-rare earth element, i.e. the high Clarke number element (relatively abundant element in the globe), based permanent magnetic materials. In recent years, the researches on several materials systems have been focused on the nanocomposite made from transition-metallic alloys, tetragonal L1o FeCo alloys, anisotropic Mn-based alloys and body centered tetragonal Fe16N2 iron nitride alloys, etc. A variety of methods are available to manufacture rare earth free, high Clarke element based permanent magnetic materials in bulk, nanostructure, nanocomposite and thin films.

How to make the high Clarke element based magnetic materials with large energy product is still big hurdle to solve. The proper scale-up methods to produce magnetic nanostructures with high energy efficiency have still been a significant challenge, which are also very important to the development of novel high Clarke element based permanent magnetic materials to meet tomorrow's energy needs.

In this paper, we outline the challenges, prospects and research status for several potential alloys with high Clarke number elements, which could replace Nd based permanent magnetic materials

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