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Additive manufacturing of high performance NdFeB Magnets

The main goal of this research is to manufacture $Nd_2Fe_{14}B$ (NdFeB) based permanent magnet and reduce the overall cost by minimize the critical material waste. One of the ways in which one can achieve this goal is by using additive manufacturing techniques to create different shapes and complex geometries of magnets without the need for tooling. Isotropic bonded magnets with a high loading fraction of 70 vol.% NdFeB are fabricated via Big Area Additive Manufacturing System that enables rapid production of large parts. The density of the printed magnet is 5.2 g/cm^3. The room temperature magnetic properties are: intrinsic coercivity H_{ci} = 8.9 kOe (708.2 kA/m), remanence B_r = 5.8 kG (0.58 Tesla), and energy product $(BH)_{max}$ = 7.3 MGOe (58.1 kJ/m^3). The as-printed magnets are then coated to improve the thermal stability as revealed by flux aging loss measurements. Tensile tests performed at 25°C and 100°C will be reported. Recently, we have attempted to print anisotropic magnets. We will report in detail about the relationship between the processing, microstructure and property of additively printed bonded magnets. This work was supported by the Critical Materials Institute, an Energy Innovation Hub funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Advanced Manufacturing Office.

Figure 1: Additively Printed NdFeB Magnets

Biography

M Parans Paranthaman is a Corporate Fellow and a Group Leader at ORNL. He is also a Distinguished UT-Battelle Inventor and has a joint faculty appointment with the University of Tennessee, Knoxville as a Professor. He earned his PhD degree in Solid State Chemistry and Materials Science from the Indian Institute of Technology, Madras in 1988. He was a Postdoctoral fellow with Professor John Goodenough (1988-1991) at the University of Texas, Austin, and a Research Associate with Professor Allen Hermann (1991-1993) at the University of Colorado, Boulder. He joined ORNL in May 1993. He has authored and co-authored over 375 journal articles, 35 US patents issued and co-edited 6 books/journal issues. His work has been cited over 14,604 times and has a h-index of 59 (Google Scholar). His present research focuses on critical materials research including additive manufacturing of permanent magnets, lithium separation from geothermal brine, and energy storage materials.

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