

MAR12-2011-008436

Abstract for an Invited Paper  
for the MAR12 Meeting of  
the American Physical Society

**Replacing critical rare earth materials in high energy density magnets<sup>1</sup>**

R. WILLIAM MCCALLUM, Ames Laboratory USDOE / Iowa State University

High energy density permanent magnets are crucial to the design of internal permanent magnet motors (IPM) for hybrid and electric vehicles and direct drive wind generators. Current motor designs use rare earth permanent magnets which easily meet the performance goals, however, the rising concerns over cost and foreign control of the current supply of rare earth resources has motivated a search for non-rare earth based permanent magnets alloys with performance metrics which allow the design of permanent magnet motors and generators without rare earth magnets. This talk will discuss the state of non-rare-earth permanent magnets and efforts to both improve the current materials and find new materials. These efforts combine first principles calculations and meso-scale magnetic modeling with advance characterization and synthesis techniques in order to advance the state of the art in non rare earth permanent magnets. The use of genetic algorithms in first principle structural calculations, combinatorial synthesis in the experimental search for materials, atom probe microscopy to characterize grain boundaries on the atomic level, and other state of the art techniques will be discussed. In addition the possibility of replacing critical rare earth elements with the most abundant rare earth Ce will be discussed.

<sup>1</sup>Work at The Ames Laboratory was supported by the U.S. DOE under Contract No. DE-AC02-07CH11358.