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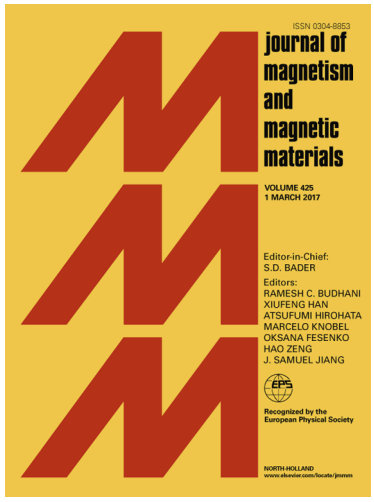

Research articles

Analytic solution of magnetic induction distribution of ideal hollow spherical field sources

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Analytic solution of magnetic induction distribution of ideal hollow spherical field sources

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Abstract

The Halbach type hollow spherical permanent magnet arrays (HSPMA) are volume compacted, energy efficient field sources, and capable of producing multi-Tesla field in the cavity of the array, which have attracted intense interests in many practical applications. Here, we present analytical solutions of magnetic induction to the ideal HSPMA in entire space, outside of array, within the cavity of array, and in the interior of the magnet. We obtain solutions using concept of magnetic charge to solve the Poisson's and Laplace's equations for the HSPMA. Using these analytical field expressions inside the material, a scalar demagnetization function is defined to approximately indicate the regions of magnetization reversal, partial demagnetization, and inverse magnetic saturation. The analytical field solution provides deeper insight into the nature of HSPMA and offer guidance in designing optimized one.

(Keywords: Spherical magnetic field source; Magnetic induction distribution; Unilateral field; Demagnetization function)

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