"Solvothermal Synthesis of Magnetic Nanoparticles" VCU #12-078

Applications

- Synthesis of magnetic nanoparticles
- Nanoparticles shaped into hard magnets for use as rare earth magnet substitutes

Advantages

- Supercritical (SCF) ethanol as solvent for synthesis is more cost-effective
- Using SCF ethanol allows product to be easily separated from solvent
- Thermal properties of particles match those of SmCo
- Greater Energy Product competitive with NdFeB
- Continuous Flow synthesis can be cheaply scaled for bulk manufacture

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Market Need

Permanent magnets are used every day in applications such as hybrid electric vehicles, wind power, magnetic refrigeration, and flywheel energy storage. Rare earth elements are often used in the production of these magnets because of their magnetic properties. However, finding alternatives to the rare earth elements can be beneficial, especially in creating a more stable market.

Nanocrystalline magnetic materials are of interest as rare earth alternatives because their magnetic properties can be controlled by altering the shape and size of the grains of the crystal. Existing wet chemical synthesis processes for magnetic materials involve using a solvent at a heat that allows for a redox reaction to take place. These processes are almost exclusively carried out using batch processing.

Technology Summary

This technology is a solvothermal synthesis technique used to produce magnetic nanoparticles to be used as a substitute for rare-earth magnets. This technique calls for supercritical (SCF) ethanol to be used as the solvent for this heat initiated reduction. Using a low boiling point alcohol as the reducing agent reduces the cost and energy consumption of the synthesis of ferromagnets. The inventors are also employing a continuous flow synthesis that allows the process to be easily and efficiently scaled from laboratory synthesis to large scale manufacture. This method creates highly crystalline Ni, Co, Fe, and their alloy nanoparticles which can be manipulated and shaped into permanent magnets.

Technology Status

Initial synthesis has been completed and product tested for magnetic properties.

Patent Pending. U.S. and Foreign rights available.

This technology is available for licensing to industry for further development and commercialization.