Production of Materials with Superior Properties Utilizing High Magnetic Field

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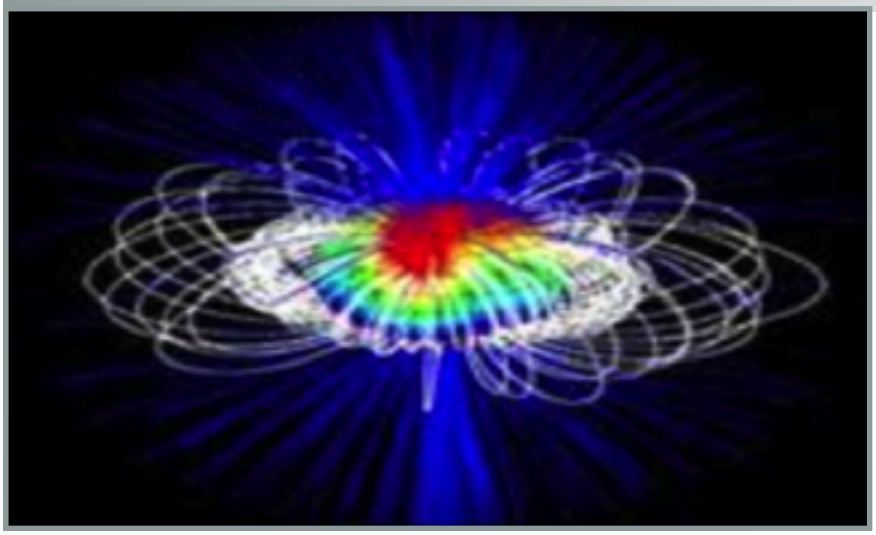

Technology Summary

Processing materials in a magnetic field is an innovative and revolutionary means to change materials and structural properties by tailoring the microstructure. Properties, equivalent or beyond, can be achieved with significantly less energy than materials treated by conventional thermal methods. New properties can also be created by manipulation of phase stability through the application of a high magnetic field.

Researchers at ORNL have developed various novel methods which offer improvements over current methods of creating materials with superior properties (structural, magnetic, electrical, optical, or acoustic). An apparatus and method have been developed for generating a magnetic field to improve the properties of the treated material through exposure to the magnetic field combined with thermal treatment. In addition, an apparatus and method have been developed for high magnetic field ohmically decoupled non-contact treatment of conductive materials in a high magnetic field to improve material properties.

For example, in metal processing alone, ORNL has developed various methods related to improving alloy production. These methods include: employing induction heating and a gas purge/quench system to provide temperature control during alloy production; the insertion and handling of ferromagnetic samples in a high magnetic field with high magnetic field gradient region without any effective forces being on the specimens; non-contacting ultrasonic treatment applied to the processing of metal alloys in either the solid and melt phase; creation of metal oxide coatings on one or more surfaces employing a magnetic field; and application of a magnetic field during solutionizing anneals in order to modify the extent of supersaturation of key elements resulting in creep strength improvement of the processed alloys.

A significant advantage of the novel methods developed is the broad applicability beyond alloy processing. The processing of materials in a magnetic field includes, but is not limited to individual parts such as diesel injectors, continuous feed materials such as wire or cables, carbon nanotubes, ceramics, and plastics, and can lead to enhancement of structural, magnetic, electrical, optical or acoustic characteristics for the materials processed.

Advantages

- Efficient production of superior strength materials in a high magnetic field
- Improvement in temperature control during alloy production
- Improvement of alloy properties and properties of any material
- Improvement in creep strength of processed alloys

Potential Applications

- Material processing
- Alloy production
- Surface coating

Patent

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John Wilgen, Roger Kisner, Gerard Ludtka, Roger Jaramillo, *High Magnetic Field Ohmically Decoupled Non-Contact Technology*, U.S. Patent No. 7,534,980, issued May 19, 2009.

Gerard Ludtka, Gail Ludtka, John Wilgen, Roger Kisner, Roger Jaramillo, *Apparatus and Method for Magnetically Processing a Specimen*, patent pending.

Gerard Ludtka, Gail Ludtka, John Wilgen, Roger Kisner, *Method of Magnetically Processing an Iron-Carbon Alloy*, patent pending.

Gerard Ludtka, Gail Ludtka, John Wilgen, Bart Murphy, *Mitigated Force Carriage for High Magnetic Field Environments*, patent pending.

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