

## MMG Publications

## Papers:

Recycling 

Recycling of rare earths: a critical review

Binnemans K, Jones PT, Blanpain B, Van Gerven T, Yang YX, Walton A, et al.  
Journal of Cleaner Production 2013;51:1-22

Multiple recycling of NdFeB-type sintered magnets

Zakotnik M, Harris IR, Williams AJ  
Journal of Alloys and Compounds 2009;469:314-21

Possible methods of recycling NdFeB-type sintered magnets using the HD/degassing process

Zakotnik M, Harris IR, Williams AJ  
Journal of Alloys and Compounds 2008;450:525-31

Hydrogen decrepitation and recycling of NdFeB-type sintered magnets

Zakotnik M, Devlin E, Harris IR, Williams AJ  
Journal of Iron and Steel Research International 2006;13:289-95.

REFeB 

Optimisation of the processing of Nd-Fe-B with dysprosium addition

Yan GL, McGuinness PJ, Farr JPG, Harris IR  
Journal of Alloys and Compounds 2010;491:L20-L4

The effects of annealing at 1000 degrees C for 24 h on the extrinsic properties of Pr-Fe-B and Nd-Fe-B-type sintered magnets

Corfield MR, Harris IR, Williams AJ  
Journal of Magnetism and Magnetic Materials 2010;322:36-45

Improvement of microstructure and magnetic properties of Nd-Fe-B alloys by Nb and Co additions

Ahmed FM, Harris IR  
Journal of Magnetism and Magnetic Materials 2008;320:2808-13

A study of the thermal demagnetisation behaviour of Nd-Fe-B sintered magnets by a magnetic field mapping system

Williams AJ, Walls R, Davies BE, Marchese J, Harris IR  
Journal of Magnetism and Magnetic Materials. 2002;242:1378-80

A comparative study of the sintering behaviour of NdFeB and PrFeB for permanent magnet applications

Taylor MG, Davies BE, Harris IR  
Journal of Magnetism and Magnetic Materials 2002;242:1375-7

Magnetic alignment and crystallographic texture relationships in permanent NdFeB magnets

Lillywhite SJ, Williams AJ, Harris IR  
Textures of Materials, Parts 1 and 2; Materials Science Forum 2002: 408-4, 1061-6

A preliminary electron backscattered diffraction study of sintered NdFeB-type magnets

Lillywhite SJ, Williams AJ, Davies BE, Harris IR  
Journal of Microscopy 2002;205:270-7

Characterisation of crystallographic texture in hot deformed Re-Fe-B by electron backscatter diffraction

Lillywhite SJ, Burns VSJ, Harris IR  
Proceedings of 17th International Workshop on Rare Earth Permanent Magnets & Their Applications, 2002, 520-527

The character and role of grain boundaries in NdFeB-type alloys and magnets

Harris IR, Williams AJ  
Zeitschrift fur Metallkunde 2002;93:983-90

The effects of annealing at 1000°C for 24 hours on the extrinsic properties of Pr-Fe-B and Nd-Fe-B-type sintered magnets

Corfield MR, Williams AJ, Harris IR  
Proceedings of 17th International Workshop on Rare Earth Permanent Magnets & Their Applications, 2002, 558-565

The magnetic properties and microstructure of hot pressed Pr-based HDDR magnets

Cannesan N, Williams AJ, Harris IR, Gutfleisch O, Le Breton JM  
Proceedings of 17th International Workshop on Rare Earth Permanent Magnets & Their Applications, 2002, 675-684

The effects of blending additions of copper and cobalt to Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> milled powder to produce sintered magnets

Mottram RS, Williams AJ, Harris IR  
Journal of Magnetism and Magnetic Materials 2001;234:80-9

The use of metal hydride powder blending in the production of NdFeB-type magnets

Mottram RS, Davis B, Yartys VA, Harris IR  
International Journal of Hydrogen Energy 2001;26:441-8

Defect formation in Nd<sub>2</sub>Fe<sub>14</sub>B grains caused by Zn diffusion

Hu Y, Harris IR, Aindow M, Jones IP  
Philosophical Magazine Letters 2001;81:233-41

Recent developments in the sintering of NdFeB

Davies BE, Mottram RS, Harris IR  
Materials Chemistry and Physics 2001;67:272-81

Production of Pr-Fe-Co-B magnets by blending with cobalt  
Ahmad A, Mottram R, Harris IR  
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Blending additions of cobalt to Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> milled powder to produce sintered magnets  
Mottram RS, Williams AJ, Harris IR  
Journal of Magnetism and Magnetic Materials 2000;217:27-34

Blending additions of aluminium and cobalt to Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> milled powder to produce sintered magnets  
Mottram RS, Williams AJ, Harris IR  
Journal of Magnetism and Magnetic Materials 2000;222:305-13

The influence of alloying additions and process parameters on the magnetic properties of PrFeB-based bonded magnets  
Faria RN, Brown DN, Harris IR  
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The effects of long term annealing at 1000°C for 24 h on the microstructure and magnetic properties of Pr-Fe-B/Nd-Fe-B magnets based on Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> and Pr<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub>  
Corfield MR, Williams AJ, Harris IR  
Journal of Alloys and Compounds 2000;296:138-47

The use of metal hydrides in powder blending for the production of NdFeB-type magnets  
Mottram RS, Kianvash A, Harris IR  
Journal of Alloys and Compounds 1999;283:282-8

Magnetic properties of polymer bonded exchange-spring NdFeB magnets  
Mokal B, Smith NA, Williams AJ, Harris IR  
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Electron microscopy studies of the oxidation of Nd-Fe-B magnets  
Li Y, Aindow M, Evans HE, Harris IR  
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Structural and magnetic properties of equiatomic rare-earth ternaries  
Kolomiets AV, Havela L, Sechovsky V, Andreev AV, Yartys VA, Harris IR  
International Journal of Hydrogen Energy 1999;24:119-27

Densification of a Nd<sub>13</sub>Fe<sub>78</sub>NbCoB<sub>7</sub>-type sintered magnet by (Nd, Dy)-hydride additions using a powder blending technique  
Kianvash A, Mottram RS, Harris IR  
Journal of Alloys and Compounds 1999;287:206-14

Microstructural and magnetic improvements in tube-cast Pr-Fe-B-Cu alloys via heat treatments and rapid upset forging  
Hatch GP, Williams AJ, Harris IR. In: Coey M, Lewis LH, Ma BM, Schrefl T, Schultz L, Fidler J, et al  
Materials Research Society Symposium Proceedings, 1999, 577, p. 69-74

A Mossbauer investigation of the homogenisation of Nd<sub>11.8</sub>Fe<sub>82.3-x</sub>Nb<sub>x</sub>B alloys  
Steyaert S, Le Breton JM, Ahmed FM, Edgley DS, Harris IR, Teillet J  
Journal of Alloys and Compounds 1998;264:277-84

Magnetic force imaging of domain structures for a (Pr/Nd)FeB alloy  
Al-Khafaji MA, Jones DGR, Rainforth WM, Gibbs MRJ, Davies HA, Harris IR  
Journal of Applied Physics 1998;83:2715-8

A study of the effects of the addition of various amounts of Cu to sintered Nd-Fe-B magnets  
Ragg OM, Harris IR  
Journal of Alloys and Compounds 1997;256:252-7

Crystallographic and magnetic alignment in hot-rolled Pr<sub>20</sub>Fe<sub>74</sub>B<sub>4</sub>Cu<sub>2</sub> alloys  
Leonowicz M, McGuinness PJ, Hatch GP, Davies HA, Harris IR  
Journal of Magnetism and Magnetic Materials 1997;166:165-71

Magnetic and mechanical properties of consolidated gas atomized and hydrogenation, disproportionation, desorption, and recombination Nd<sub>2</sub>Fe<sub>14</sub>B powders  
Horton JA, Heatherly L, Sellers CH, Branagan DJ, Ragg O, Harris IR  
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Consolidation, magnetic and mechanical properties of gas atomized and HDDR Nd<sub>2</sub>Fe<sub>14</sub>B powders  
Horton JA, Heatherly L, Branagan DJ, Sellers CH, Ragg O, Harris IR  
IEEE Transactions on Magnetics 1997;33:3835-7

Production of coercive as-forged PrFeBCu magnets using multiple hot deformation rates  
Williams AJ, Hatch GP, Bowen P, Harris IR, Marcondes PVP  
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Improvement in the mechanical properties of PTFE bonded Nd-Fe-B magnets by heat treatment  
Tattam C, Williams AJ, Hay JN, Harris IR, Tedstone SF, Ashraf MM  
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Hot pressing Nd-Fe-B HDDR powder  
Ragg OM, Harris IR, Nagel H, Bohm P  
IEEE Transactions on Magnetics 1996;32:4395-7

The production and characterisation of PTFE bonded Nd-Fe-B magnets  
Mokal B, Williams AJ, Hay JN, Harris IR  
Proceedings of 14th International Workshop on Rare Earth Permanent Magnets & Their Applications, 1996, A511-A520

The processing characteristics of (Nd,Pr)-Fe-B permanent magnet alloys  
Jones DGR, de Kort K, Harris IR

Upset forging of an as-cast Pr-Fe-B-Cu alloy in air  
Hatch GP, Williams AJ, Mycock GJ, Harris IR  
Journal of Magnetism and Magnetic Materials 1996;157:69-70

Properties and alignment of Pr-Fe-B-Cu magnets produced by rapid upset forging in air  
Hatch GP, Williams AJ, Harris IR, Mycock GY  
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Metallurgical processing of Nd<sub>2</sub>Fe<sub>14</sub>B type permanent magnetic alloys  
Zhang XJ, Yin XJ, McGuinness PJ, Harris IR  
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Investigation of the homogenization behaviour of NdFeB alloys  
Ahmed FM, Edgley DS, Harris IR  
Journal of Alloys and Compounds 1995;224:135-9

The use of polytetrafluoroethylene in the production of high-density bonded Nd-Fe-B magnets  
Tattam C, Williams AJ, Hay JN, Harris IR, Tedstone SF, Ashraf MM  
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A study of the effects of heat treatment on the microstructures and magnetic properties of Cu-added Nd-Fe-B type sintered magnets  
Ragg OM, Harris IR  
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Effect of niobium addition on the Nd-Fe-B alloy and magnet  
Ahmed FM, Edgley DS, Harris IR  
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Homogenization behaviour of Nd<sub>2</sub>(Fe<sub>0.98</sub>Nb<sub>0.02</sub>)<sub>14</sub>B alloy  
Ahmed FM, Edgley DS, Gutfleisch O, Harris IR  
IEEE Transactions on Magnetics 1994;30:616-8

The microstructural characterization of Nd-Fe-B alloys. 2. Microstructural investigation of cast Nd-Fe-B materials  
Yin XJ, Jones IP, Harris IR.  
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The microstructural characterization of Nd-Fe-B alloys. 1. Light element microanalysis  
Yin XJ, Hall MG, Jones IP, Faria RN, Harris IR  
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A study of the effect of Cu-addition on the annealing behaviour and microstructures of Nd-Fe-B sintered magnets  
Ragg OM, Harris IR  
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The microstructures and magnetic-properties of some cast and annealed Pr-Fe-Cu-B alloys  
Mycock GJ, Faria RNJ, Harris IR  
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The microstructures and magnetic-properties of some cast and annealed Pr-Fe-Cu-B alloys  
Mycock GJ, Faria RNJ, Harris IR  
Journal of Alloys and Compounds 1993;201:23-8

Magnetic-anisotropy in arc-cast Nd-Fe-B-Zr alloys  
Fujita A, Harris IR  
IEEE Transactions on Magnetics 1993;29:2803-5

Dissociation of Nd<sub>2</sub>Fe<sub>14</sub>B during high-temperature oxidation  
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Analytical TEM studies of Nd-Fe-B containing V, Co and Dy  
Yin XJ, Jones IP, Harris IR  
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HDDR hot-pressed magnets – magnetic-properties and microstructure  
McGuinness PJ, Zhang XJ, Knoch KG, Yin XJ, Wyborn MJ, Harris IR  
Journal of Magnetism and Magnetic Materials 1992;104:1169-70

Anisotropic HDDR epoxy bonded magnets from NdFeBZr.  
McGuinness PJ, Short CL, Harris IR  
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The production and characterisation of bonded hot-pressed and die-upset HDDR magnets  
McGuinness PJ, Short C, Wilson AF, Harris IR  
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A study of Pr-Fe-B-Cu permanent magnetic-alloys  
Kwon HW, Bowen P, Harris IR  
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Study of Pr-Fe-B-Cu permanent-magnets produced by upset forging of cast ingot  
Kwon HW, Bowen P, Harris IR  
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Nd-Fe-B-based magnets – magnetic-properties and microstructural appearance with copper addition  
Knoch KG, Kianvash A, Harris IR

Journal of Alloys and Compounds 1992;183:54-8

Nd-Fe-B-Cu HD-processed sintered magnets – properties and microstructure

Knoch KG, Kianvash A, Harris IR  
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Preparation of a new ternary phase Nd<sub>30</sub>Fe<sub>65</sub>Cu<sub>5</sub>

Knoch KG, Harris IR.  
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The effect of the cooling rate on the intrinsic-coercivity of some Nd-Fe-B based permanent-magnets

Kianvash A, Knoch KG, Harris IR  
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Microstructural and magnetic studies on Pr-Fe-B-Cu alloys

Kwon HW, Bowen P, Harris IR  
Journal of Applied Physics 1991;70:6357-9

Magnetic-properties of the sintered magnets produced from a Nd-Fe-B-Cu-type material

Kianvash A, Harris IR  
Journal of Applied Physics 1991;70:6453-5

Structural-analysis of the hard ferromagnetic phase observed in quenched Nd-Fe alloys of hyper-eutectic composition

Givord D, Noziers JP, Rossignol MF, Taylor DW, Harris IR, Fruchart D, et al  
Journal of Alloys and Compounds 1991;176:L5-L11

The effect of aging at 500°C on Nb-containing Nd-Fe-B magnets

Freeman RJ, Swain H, Harris IR  
Journal of Applied Physics 1991;70:6606-8

Controlled solidification and magnetic properties of Pr-Fe-B-Cu and Nd-Fe-B alloys

Faria RN, Abell JS, Harris IR  
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The magnetic and mechanical-properties of NdFeB type permanent-magnets and the effect of quenching

Withey PA, Kennett HM, Bowen P, Harris IR  
IEEE Transactions on Magnetics 1990;26:2619-21

Anisotropy induced by the rotary forging of rapidly quenched Nd-Fe-B ribbons

Rowlinson N, Ashraf MM, Harris IR  
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Magnetic and mechanical-properties of rotary forged aluminum compacted Nd-Fe-B magnets

Brett RL, Rowlinson N, Ashraf MM, Harris IR, Bowen P  
Journal of Applied Physics 1990;67:4622-4

A study of the microstructures and the effects of coating on Nd<sub>2</sub>Fe<sub>14</sub>B alloys

Ahmad A, McGuinness PJ, Harris IR  
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Aging effects in Nd(Dy)Fe(Nb)B alloys and magnets

Withey PA, Devlin EJ, Abell JS, Harris IR  
Journal of Magnetism and Magnetic Materials 1989;80:67-70

New developments in bonded Nd-Fe-B magnets

Rowlinson N, Ashraf MM, Harris IR  
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Sintering behavior of NdFeB magnets

McGuinness PJ, Williams AJ, Harris IR, Rozendaal E, Ormerod J  
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Modification of the microstructure of Nd<sub>15</sub>Fe<sub>77</sub>B<sub>8</sub> alloy by controlled solidification

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Microhardness studies of a Nd-Fe-B permanent-magnet alloy

Bailey T, Harris IR  
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## Hydrogen Processing of REFeB



Anisotropic powder from sintered NdFeB magnets by the HDDR processing route

Sheridan RS, Sillitoe R, Zakotnik M, Harris IR, Williams AJ  
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Effect of microstructural orientation on in situ electrical resistance monitoring during S-HDDR processing of a Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> alloy

Hu LX, Williams AJ, Harris IR  
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Intermediate lamellae phase in lightly disproportionated NdFeB-type alloys

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The evolution of the disproportionated microstructure of PrFeB-based alloys

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Yi G, Chapman JN, Brown DN, Harris IR  
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Metastable borides and the inducement of texture in Pr<sub>2</sub>Fe<sub>14</sub>B-type magnets produced by HDDR

Gutfleisch O, Teresiak A, Gebel B, Muller KH, Cannesan NB, Brown D, et al  
IEEE Transactions on Magnetics 2001;37:2471-3

The production and characterisation of highly anisotropic PrFeCoB-type HDDR powders

Cannesan N, Brown DN, Williams AJ, Harris IR  
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TEM studies of the effects of Zr additions on some HDDR-processed, high boron, NdFeB-type powders and hot-pressed magnets

Yi G, Chapman JN, Brown DN, Harris IR  
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Microstructural and magnetic studies of cast and annealed Nd and PrFeCoBZr alloys and HDDR materials

Faria RN, Davies BE, Brown DN, Harris IR  
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A comparison of the micromagnetic and microstructural properties of four NdFeB-type materials processed by the HDDR route

Thompson P, Gutfleisch O, Chapman JN, Harris IR  
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Application of hydrogen vibration milling in the processing of NdFeB and (Nd,Pr)FeB permanent magnets

Mottram RS, Yartys V, Guegan PW, Harris IR  
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The production of a Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> sintered magnet by the hydrogen decrepitation/hydrogen vibration milling route

Kianvash A, Harris IR  
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Microstructural study of Nd-Fe-Co-Ga-B magnet during hydrogenation disproportionation process

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High anisotropy in Pr-Fe-Co-B-ZrHDDR powders

Faria RN, Williams AJ, Harris IR  
Journal of Alloys and Compounds 1999;287:L10-L2

Permeameter measurements of anisotropic PrFeCoBZr hydrogenation disproportionation desorption and recombination (HDDR) magnets

Faria RN, Williams AJ, Harris IR  
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Microstructural and magnetic studies of HDDR magnets from high boron NdFeB(Zr) alloys

Brown DN, Williams AJ, Gutfleisch O, Strangwood M, Harris IR  
Materials Research Society Symposium Proceedings, 1999, 577, p. 47-55

A magnetic and compositional study of the disproportionated stage of the solid-HDDR process in NdFeB-type materials

Thompson P, Gutfleisch O, Chapman JN, Harris IR, Nicholson WAP  
Journal of Alloys and Compounds 1998;281:12-6

Domain studies in thin sections of HDDR-processed Nd-Fe-B-type magnets by TEM

Thompson P, Gutfleisch O, Chapman JN, Harris IR  
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The influence of free iron on the hydrogen decrepitation capability of some Nd(Pr)-Fe-B alloys

Kianvash A, Harris IR  
Journal of Alloys and Compounds 1998;279:245-51

Backward extruded NdFeB HDDR ring magnets

Gutfleisch O, Kirchner A, Grunberger W, Hinz D, Schafer R, Schultz L, et al  
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Textured NdFeB HDDR magnets produced by die-upsetting and backward extrusion

Gutfleisch O, Kirchner A, Grunberger W, Hinz D, Nagel H, Thompson P, et al  
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Further studies of hydrogenation, disproportionation, desorption and recombination processes in a Nd<sub>5</sub>Fe<sub>2</sub>B<sub>6</sub> boride

Yartys VA, Gutfleisch O, Harris IR  
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The relation between the micromagnetic and microstructural properties of HDDR-processed Nd-Fe-B-type materials

Thompson P, Gutfleisch O, Chapman JN, Harris IR  
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Resistivity measurements on hydrogenation disproportionation desorption recombination phenomena in Nd-Fe-B alloys with Co, Ga and Zr additions

Sugimoto S, Gutfleisch O, Harris IR  
Journal of Alloys and Compounds 1997;260:284-91

The HD and HDDR processes in the production of Nd-Fe-B permanent magnets

Ragg OM, Keegan G, Nagel H, Harris IR

International Journal of Hydrogen Energy 1997;22:333-42

HDDR processing of direct-reduced Nd<sub>15</sub>Fe<sub>77-x</sub>B<sub>8</sub>Ga<sub>x</sub> powders

Burkhardt C, Matzinger M, Steinhorst M, Fidler J, Harris IR

Journal of Magnetism and Magnetic Materials 1997;169:69-81

Further studies of anisotropic hydrogen decrepitation in Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> sintered magnets

Yartys VA, Williams AJ, Knoch KG, McGuinness PJ, Harris IR

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Hydrogen-induced phase and magnetic transformations in Nd<sub>1.1</sub>Fe<sub>4</sub>B<sub>4</sub>

Yartys VA, Gutfleisch O, Harris IR

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S-HDDR induced cavitation in NdFeB

Williams AJ, Gutfleisch O, Harris IR

Journal of Alloys and Compounds 1996;232:L22-L6

HDDR processes in Nd<sub>16</sub>Fe<sub>76-x</sub>Zr<sub>x</sub>B<sub>8</sub> alloys and the production of anisotropic magnets

Short CL, Guegan P, Gutfleisch O, Ragg OM, Harris IR

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Recent developments in the study of HDDR materials

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Microstructure of solid-HDDR Nd-Fe-B:Zr magnets

Matzinger M, Fidler J, Fujita A, Harris IR

Journal of Magnetism and Magnetic Materials 1996;157:54-6

Study of the effect of HDDR processing conditions on properties and microstructure of Nd-(Fe,Co,Ga)-B magnetic powders

Martinez N, deAngulo LR, Harris IR

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Studies of HDDR processes in the Nd<sub>1.1</sub>Fe<sub>4</sub>B<sub>4</sub> boride

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Fundamental and practical aspects of the hydrogenation, disproportionation, desorption and recombination process

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Solidification of the Nd-rich intergranular phase during HDDR processing of Nd-Fe-B type alloys

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Magnetic properties of Pr-Fe-B sintered magnets produced from hydride powder and from partially and totally desorbed hydride powder

Faria RN, Williams AJ, Abell JS, Harris IR

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Microstructural study of hot pressed HDDR Nd-Fe-B magnets

Estevez E, Fidler J, Short C, Harris IR

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Studies of the HDDR reaction in stoichiometric Nd-Fe-B alloys with and without Nb additions

Clarke JC, Ahmed FM, Harris IR

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Detailed SEM studies of the HDDR behaviour of direct-reduced Nd<sub>15</sub>Fe<sub>77</sub>B<sub>8</sub> and Nd<sub>15</sub>Fe<sub>77-x</sub>B<sub>8</sub>Ga<sub>x</sub> powders

Burkhardt C, Steinhorst M, Harris IR

Journal of Alloys and Compounds 1996;237:113-20

A new method for in-situ magnetisation measurements during hydrogenation of RE-Fe-B type materials

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Effect of niobium on the HDDR behaviour of near-stoichiometric NdFeB alloys

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HDDR behaviour of Nb-containing Nd-Fe-B near-stoichiometric alloys

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Critical parameters of HDDR processing of NdFeB alloys

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Detailed TEM analysis of solid-HDDR of Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> magnetic materials

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IEEE Transactions on Magnetics 1995;31:3635-7

Characterization of solid-HDDR processed Nd<sub>16</sub>Fe<sub>76</sub>B<sub>8</sub> alloys by means of electron-microscopy

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In-situ electrical-resistivity measurements – study of magnetic and phase-transitions and solid-HDDR processes in Nd-Fe-B-type alloys

Gutfleisch O, Harris IR  
Journal of Materials Science 1995;30:1397-404

Hydrogenation disproportionation desorption and recombination (HDDR) studies on direct-reduce Nd<sub>15</sub>Fe<sub>77</sub>-XB<sub>8</sub>GaX powders

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