67 D. T. Hughes and I. R. Harris, *Z. Phys. Chem. Neue Folge*, 1979, **117**, 185
68 D. A. Smith, I. P. Jones and I. R. Harris, *J. Less-Common Met.*, 1984, **103**, 33
69 Y. Sakamoto, T. B. Flanagan and T. Kuji, *Z. Phys. Chem. Neue Folge.*, 1985, **143**, 61
70 M. L. Doyle and I. R. Harris, *Z. Phys. Chem. Neue Folge*, 1989, **163**, 59
71 D. Watanabe, *Trans. Jpn. Inst. Met.*, 1962, **3**, 234
72 J. W. Cable, E. O. Wollan, W. C. Koehler and H. R. Child, *Phys. Rev.*, 1962, **128**, 2118
73 H. Sato and R. S. Toth, *Phys. Rev.*, 1965, **139**, 1581
74 H. Iwasaki, K. Okamura and S. Ogawa, *J. Phys. Soc. Jpn.*, 1971, **31**, 497
75 J. Gjönnes and A. Olsen, *Phys. Status Solidi (a)*, 1973, **17**
76 P. J. Ahlzèn, Y. Andersson, R. Tellgren, D. Rodic, T. B. Flanagan and Y. Sakamoto, *Z. Phys. Chem. Neue Folge.*, 1989, **163**, 213
77 T. B. Flanagan, A. P. Craft,T. Kuji, K. Baba and Y. Sakamoto, *Scr. Metall.*, 1986, **20**, 1745
78 K. Baba, Y. Sakamoto, T. B. Flanagan, T. Kuji and A. Craft, *Scr. Metall.*, 1987, **21**, 299
79 K. Baba, Y. Niki, Y. Sakamoto, T. B. Flanagan and A. Craft, *Scr. Metall.*, 1987, **21**, 1147
80 A. P. Craft, R. Foley, T. B. Flanagan, K. Baba, Y. Niki and Y. Sakamoto, *Scr. Metall.*, 1988, **22**, 511
81 K. Baba, Y. Niki, Y. Sakamoto, A. P. Craft and T. B. Flanagan, *J. Mater. Sci. Lett.*, 1988, 7, 1160
82 K. Baba, Y. Niki, Y. Sakamoto and T. B. Flanagan, *J. Less-Common Met.*, 1991, **172–174**, 246
83 T. B. Flanagan, A. Craft, Y. Niki, K. Baba and Y. Sakamoto, *J. Alloys Compd.*, 1992, **184**, 69
84 Y. Sakamoto, K. Baba, Y. Niki, Y. Ishibashi and T. B. Flanagan, *J. Alloys Compd.*, 1992, **184**, 57
85 K. Baba, Y. Niki, Y. Sakamoto and T. B. Flanagan, *J. Alloys Compd.*, 1992,**179**, 321
86 P. Ahlzèn, Y. Andersson, R. Tellgren, T. B. Flanagan and Y. Sakamoto, to be published
87 E. Salomons, N. Koeman, J. Rector and R. Griessen, *J. Phys. Condens. Matter*, 1990, **2**, 835
88 Y. Sakamoto, K. Takao and T. B. Flanagan to be published
89 V. Degtyareva, V. Antonova, I. Belash and E. Ponyatovski, *Phys. Status Solidi (a)*, 1981, **66**, 77
90 V. Antonov, V. Antonova, I. Belash, E. Ponyatovski and V. Rashuptkin, *Phys. Status Solidi (a)*, 1983, **78**, 137
91 V. Antonov, V. Antonova, I. Belash and E. Ponyatovski, *Phys. Met. Metall.*, 1984, **57**, 671
92 A. Irodova, V. Glazkov, V. Somenkov, T. Kurchatov, V. Antonov and E. Ponyatovski, *Z. Phys. Chem. Neue Folge*, 1989, **163**, 53
93 E. Raub, H. Beeskow and D. Menzel, *Z. Metallkd.*, 1959, **50**, 428
94 H. Noh, T. B. Flanagan and M. Ransick, *Scr. Metall. Mater.*, 1992, **26**, 353

Rhodium Alloys for Magnetocooling Devices

It appears that the efficiency of the traditional methods of thermomechanical refrigeration cannot be improved further, and therefore there is a need to find alternatives. One such method could be magnetocaloric refrigeration, which is based on the reversible heating and cooling of a medium when its magnetisation is changed. However, this requires the use of suitable magnetic materials which display good field-induced entropy changes over a wide temperature range.

Although the antiferromagnetic-ferromagnetic phase transition in rhodium-iron alloys has been investigated previously, there have not been many experimental determinations of the thermomagnetic properties of these alloys. Now researchers at Moscow State University, Russia, and at Turkmen State University, Turkmenia, have reported the results of their studies. They investigated the temperature dependence of initial magnetic permeability, specific heat capacity and the magnetocaloric effect in both annealed and quenched samples of 49 iron-51 rhodium alloys near to the antiferromagnetic-ferromagnetic first-order transition, (M. P. Annaorazov, K. A. Asatryan, G. Myalikgulyev, S. A. Nikitin, A. M. Tishin and A. L. Tyurin, *Cryogenics*, 1992, **32**, (10), 867–872).

Polycrystalline samples made by induction melting rhodium and iron in argon were homogenised by annealing for 72 hours at 1300 K under vacuum, followed by slow cooling to room temperature. A temperature drop of 12.9 K occurred under adiabatic conditions when a magnetic field of about 2 T was applied to a quenched sample at 308.2 K. The behaviour and the value of the magnetocaloric effect were very sensitive both to heat treatment and to the applied field. The value of the refrigerant capacity of a quenched sample of the alloy at a field of 1.95 T, determined from magnetocaloric temperature changes combined with zero-field specific heat data, was 135.22 J/kg T. This is significantly greater than the refrigerant capacity of gadolinium, which is regarded as a useful material for magnetocaloric refrigeration. Therefore rhodium-iron alloys are considered to be suitable materials for use in stage magnetic refrigerators. The transition temperature of this binary system may be changed by dilution with 3d, 4d and 5d transition elements.