하나로
HANARO

KAERI / GP-201 / 2003

Abstracts of

HANARO Workshop 2003

-이용자 중심의 열린 하나로-

- 일 시 : 2003. 5. 16(금) 08:30~18:30
- 장 소 : 한국원자력연구소 국제원자력교육훈련센터(INTEC)
- 주 최 : 한국원자력연구소
- 후 원 : 과학기술부, 한국원자력학회, 한국물리학회
  한국분석과학회, 대한금속재료학회, 대한핵의학회

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논문 분야 : NB-P3

$Ti_{1-x}{}^{57}Fe_xO_2$ 의 중성자 회절 및 뫼스바우어 분광학적 연구

Neutron Diffraction and Mössbauer studies of $Ti_{1-x}{}^{57}Fe_xO_2$

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요 약 문

Diluted magnetic semiconductors (DMS) have extensively been studied, because these materials are promising candidates for application of spin-dependent electronic devices. In spite of numerous studies carried out in this type of DMS, no practical application of these materials has been realized. Most of the reason that hampered application may be a low Curie transition temperature of DMS materials. On the other hand, owing to recent intensive studies, new DMSs were discovered such as $Ti_{1-x}Co_xO_2$, Mn doped $CdGeP_2$, and zinc blende CrAs with room temperature ferromagnetism. $Ti_{1-x}{}^{57}Fe_xO_2$ compounds were fabricated using the chemical solution method, and the crystal structure and ferromagnetic properties were investigated as a function of doped ^{57}Fe concentration. X-ray and neutron diffraction patterns showed a pure anatase single phase, without any segregation of Fe into particulates within the instrumental resolution limit. Magnetic properties were characterized by vibrating sample magnetometer (VSM) and Mössbauer spectroscopy with a $^{57}Co(Rh)$ source. With varying ^{57}Fe concentration, we could observe unusual magnetic phenomena in these materials. Doping ^{57}Fe into the TiO_2 nonmagnetic semiconductor formed magnetic properties, but the gradual increase of ^{57}Fe concentration dropped rapidly ferromagnetic properties rather than enhanced ferromagnetic properties. This result reveals an interesting feature that there is a critical limit of ^{57}Fe concentration to get ferromagnetic properties at room temperature.