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Investigation of the Fe Binding Properties in $Zr(Al_xFe_{1-x})_2$ by Nuclear Resonant Photon Scattering*

By I. Jacob[1], A. Israel[1], R. Moreh[1,2] and A. Wolf[2]

[1] Ben Gurion University of the Negev, Beer Sheva 84105, Israel
[2] Nuclear Research Center-Negev, Beer Sheva 84190, Israel

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A study of the iron binding properties in the $Zr(Al_xFe_{1-x})_2$ system, $x = 0, 0.083, 0.2$, is made by utilizing the nuclear resonant photon scattering (NRPS) of 8.512 MeV γ rays from ^{56}Fe. Large samples of $Zr(Al_xFe_{1-x})_2$ compounds, about 200 g each, were introduced into the photon beam emitted by a $Cr(n,\gamma)$ source. The scattered 8.512 MeV γ radiation was detected by a large, 130 cm^3 HPGe detector. An experimental set-up was designed to enable a direct comparison of the scattered intensities, thus obviating complicated self-absorption and geometrical corrections. A substitution of small amounts of Fe in $ZrFe_2$ by Al, $x = 0.083, 0.2$ was found to cause a reduction of the resonantly scattered intensity. This result indicates a softening of the Fe bonding strength in the corresponding compounds. Since such a substitution is also known to cause a large increase in the hydrogen absorption capacity, our results seem to conform with a prediction of the rule of reverse capacity.

1. Introduction

Nuclear resonant photon scattering (NRPS) of 6–9 MeV gamma rays may be utilized to study the bonding strength of specific metallic elements in different compounds. Explanatory remarks and terminology associated with NRPS, as well as the known resonant nuclei suitable for such a research, may be found in [1, 2] and references therein. We only briefly mention here that the terms resonant scattering intensity (RSI), effective temperature, T_e, vibrational energy and bonding strength are interrelated to each other and designate how strong a specific atom is bound in a certain compound. Recent investigation of the resonantly scattered intensity of

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