SOUND VELOCITY AND ULTRASONIC ATTENUATION ANOMALIES IN LIQUID BISMUTH-GALLIUM AND BISMUTH-TIN ALLOYS

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The temperature dependence of the sound velocity and ultrasonic attenuation in several liquid Bi-Ga and Bi-Sn alloys was determined by means of an ultrasonic pulse technique. The sound velocity was shown to be linear with temperature and parabolic with concentration in Bi-Sn alloys and in Bi-Ga in the miscibility region. This behavior indicates a correlation between the variation of the electrical resistivity and the sound velocity. The ultrasonic attenuation and its temperature dependence were found to vary as the square of the frequency in the range between 5-100 MHz. The anomalous behavior of the ultrasonic attenuation in the vicinity of the critical points indicates the occurrence of concentration fluctuations responsible for the rapid gravitational separation observed at 262°C for the critical composition in the Bi-43.77 wgr.% Ga alloy. Ultrasonic attenuation measurements permitted the accurate determination of the position of the interface (meniscus) between the separated liquid phases. The rate of motion of the meniscus as a function of temperature and composition was measured.

REFERENCE:

AN NMR STUDY OF THE PLUTONIUM HYDRIDE SYSTEM

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An NMR study was conducted on protons in the nonstoichiometric plutonium hydride system, PuHx. The following compositions were studied: x = 1.78, 2.35, 2.65 and 2.78. The lineshapes, Knight shifts (K), spin-spin relaxation times (T2), and spin-lattice relaxation times (T1) were measured in the temperature range 77-300⁰K. The results indicate the existence of paramagnetic phases at high temperatures, with localized 5f moments on the Pu ions, and possible magnetically ordered phases at low temperatures. The predicted transition temperatures and type of magnetic order were found to depend strongly on the hydrogen concentration. Different lineshapes and shifts are found for the tetrahedral and octahedral protons, which indicate a different bound state for the hydrogen ions. The hydrogen self-diffusion constants were derived from.

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$T_2$ measurements in the motionally narrowed regime, and were found to be quite similar to those found in the LaH$_x$ system. $T_1 T$ as well as $(K-K_0)^{-1}$ were found to be linear with temperature. The proportionality constant was found to be composition independent. The possible magnetic couplings between the protons and the paramagnetic moments were considered.

**NMR STUDY OF HYDROGEN DIFFUSION IN URANIUM HYDRIDE**

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The diffusion of hydrogen in uranium hydride was studied employing the NMR technique. From measurements of spin-spin relaxation time $T_2$, the activation energy for hydrogen diffusion in $\beta$-UH$_3$ was determined to be $E_a = (19.25 \pm 0.4)$ kcal/mole and the preexponential factor to be $A_0 \approx 5 \times 10^{14}$ Hz. It was shown that these results are in fair agreement with spin-lattice relaxation time $T_1$ data. Assuming that hydrogen diffusion proceeds via vacancies whose concentration is temperature dependent, it was concluded that $E_a$ is the sum of the energies of vacancy formation and barrier height, and that $A_0$ contains an entropy change factor. Using vacancy concentration data calculated by Libowitz and Gibb, the barrier height energy was estimated to be $E_b \approx 7$ kcal/mole. Using a value for the frequency of hydrogen vibration $\nu_0$ determined from inelastic neutron scattering by Rush et al., the entropy change due to vacancy formation and the hydrogen atom jump was estimated to be $S/k_B \approx 3$. Similar measurements on samples containing less hydrogen than is needed to compose stoichiometric UH$_3$ showed that the rate of diffusion is enhanced by the presence of excess metal in the sample. The jump frequency at 500 K in UH$_3$ was found to be approximately $10^6$ Hz, while for the two-phase samples of H/U=2.8 and 2.5, it was found to be larger by a factor of about 3 and 3.5, respectively.

**REFERENCES:**