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The Temperature and Pressure Dependence of the Nuclear Resonance of Co^{59} in Face-Centered-Cubic Cobalt Metal

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Recently the nuclear resonance of Co^{59} in ferromagnetic f.c.c. cobalt metal was observed by Gossard and Portis¹⁾. The resonance frequency is 213.1 Mc/sec in zero external magnetic field at room temperature. This indicates an effective magnetic field of 213 400 oersteds at the site of the nucleus, since the nucleus has a magnetic moment of 4.583 nuclear magnetons and a spin number of 7/2. The effective field arises from the hyperfine interaction between the nucleus and both the core and the conduction electrons, as has been discussed by Marshall²⁾, and can be written as

$$H_{eff} = \lambda AM,$$

where λ is a constant, A represents the hyperfine interaction and M the magnetization.

As in the case of the fluorine resonance in anti-ferromagnetic MnF_2 ³⁾⁴⁾, knowledge of the temperature and the pressure dependence of the resonance frequency will give detailed information about the hyperfine interaction. Therefore, measurements were made in the range from liquid oxygen temperature to 550°C⁵⁾ and in the pressure range 1 to 8000 kg/cm². The spectrometer was the one used by one of the authors for the line-width study of pure quadrupole resonance, which has been described elsewhere.⁶⁾ It was frequency-modulated, and

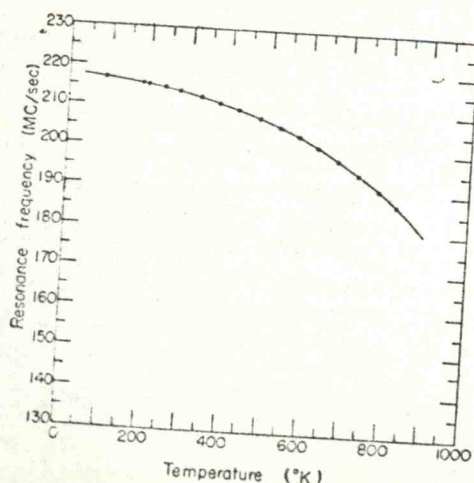


Fig. 1. The temperature dependence of the resonance frequency at atmospheric pressure.

the resonance was displayed on an oscilloscope. The probable error in the determination of the resonance frequency was ± 0.1 Mc/sec.

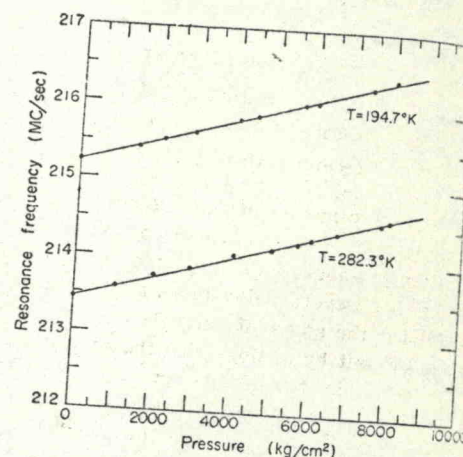


Fig. 2. The pressure dependence of the resonance frequency at 194.7° and 282.3°K.

The results of the measurements are shown in Figs. 1 and 2. The resonance frequency seems to have the same temperature dependence as M , the temperature dependence would be primarily due to the change in M . However, the change in A would be responsible for the pressure dependence, since M is likely to depend little on pressure⁷⁾. In order to obtain a definite conclusion at these points, and to know the detailed nature of the interaction, measurements of the temperature and the pressure dependence of M are necessary and now in preparation.

The details of the experimental procedures and the discussions of the results will be published later.

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