Letter

**Mössbauer Spectrum of Ilmenite (FeTiO_3)
below the Néel Temperature**

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Mössbauer analysis of Apollo 11 lunar samples has led to comparisons between terrestrial and lunar ilmenite FeTiO_3 . Investigations of lunar ilmenite have indicated that in all samples examined, ilmenite was homogeneous, well ordered and very nearly stoichiometric FeTiO_3 , containing less than 0.5% Fe_2O_3 (Muir *et al.*, 1971).

Mössbauer spectra of original lunar fines at low temperatures have been analysed (Huffman *et al.*, 1971) by comparison with previous results obtained for terrestrial ilmenite below its anti-ferromagnetic transition temperature (Shirane *et al.*, 1962). We report here recent Mössbauer results obtained for synthetic ilmenite in the anti-ferromagnetic region which differs in detail from previously published results.

The ilmenite sample was synthesized by weighing and mixing appropriate amounts of Fe, TiO_2 and Fe_2O_3 (all 99.95% or better) in an inert atmosphere. The mixture was sealed in a quartz tube under a pressure of less than 10^{-3} Torr, slowly heated to 1150°C , and quenched after 10 hr at that temperature. The single phase nature of the sample was confirmed by X-ray diffraction. Several Mössbauer spectra were taken of this sample above and below its Néel temperature using standard Mössbauer experimental techniques.

Spectra taken above 55°K contained only two well-defined peaks indicating that Fe^{3+} was not present and Fe^{2+} does not exist on non-equivalent lattice sites. Mössbauer parameters determined from these spectra are in good agreement with those obtained previously (Shirane *et al.*, 1962). A spectrum taken at 15°K consisting of 3×10^6 counts per channel is shown in Fig. 1, where a six-peak spectrum is clearly resolved. This spectrum is to be compared with the *three-* peak spectrum obtained by Shirane *et al.* The spectrum of Fig. 1 was resolved on a digital computer using an unconstrained least squares Lorentzian fitting program. Detailed analysis of the spectrum using a program developed by Kundig (1967) yields a value of 47 ± 1 KOe for the internal magnetic field (H_i), a value considerably lower than that obtained from the analysis of the three-peak spectrum which gave $H_i = 70$ KOe. From the present results, a quadrupole splitting of 1.26 ± 0.1 mm/sec is obtained to be compared with a value of 1.14 mm/sec obtained by Shirane *et al.* The isomer shift at 15°K is also consistent with the previously obtained value.

Fig. 1 Mössbauer Spectrum of terrestrial ilmenite at $T < T_n$.

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