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Many rare earth compounds are known to fluoresce. However, promethium, element 61, has not been extensively studied, in fact only the solution and emission spectra have been observed.[1-5] The difficulties stem from the fact that promethium is intensely radioactive and is not available from natural sources. Promethium is available in large quantities as a fission product of uranium. The isotope of promethium that is available in quantities is Pm^{147} which has a 2.6-yr half life and a 0.22-Mev β^- ray. The decay product is stable Sm^{147}. Carlson and Dieke have noted that most rare earths fluoresce in a $LaCl_3$ matrix.[6] It is therefore very reasonable to expect that promethium would also fluoresce.

Two crystals were prepared, one containing 1 gm $LaCl_3$ and 20 mg $PmCl_3$ and the second, 1 gm $LaCl_3$ and 2 mg of $PmCl_3$. The crystals were prepared following the method outlined by Gruen et al.[7] The promethium was purified by ion-exchange techniques before incorporation into the crystal.

These crystals exhibited several interesting features. (a) The crystals are self luminescent. In this case the luminescense is activated by the energy given to the crystal by the radioactive decay. (b) As the crystal cools to room temperature, it gradually blackens. This darkening saturates in about 1/2 to 1 hr, depending on the concentration of promethium. The crystal is almost opaque at saturation time. The darkening may be bleached with heat or light. We believe the darkening is due to the trapping of free electrons into crystal defects (color centers). The source of the electrons is the soft β^-'s emitted by the decaying Pm^{147}. The β^-'s are degraded in the crystal and finally captured in the defects. (c) The crystal fluoresces. In the 2% crystal, the multiplet at 8300 A is intensified by irradiation with ultraviolet light. This multiplet is more than 10 times as intense under ultraviolet irradiation as in self-luminescence. This of course depends on the

*This work was done under the auspices of the U. S. Atomic Energy Commission.

intensity of the incident ultraviolet radiation. The visible spectrum is not noticably enhanced by ultraviolet irradiation. In the 0.2% crystal, all lines were intensified by ultraviolet irradiation.

Spectra were taken on a Hilger f/4 spectrograph with quarts optics. Under this low dispersion, 34 lines could be seen on the photographic plate. Most of the lines were in seven groupings. The groupings of the promethium luminescence lines were at 4610, 4980, 5410, 5900, 6600, 7420, 8300 A. Spectra of $SmCl_3$ in $LaCl_3$ were also taken to determine the extent to which this element had grown into the promethium crystal. The strong fluorescent lines of samarium, which appear in a region free of promethium lines, were not detected, and it is concluded that all the luminescence is due to promethium.

The luminescence is due to transitions from excited levels to the ground-state multiplet which according to Hund's rules is a ^5I having J values of 4, 5, 6, 7, and 8, with J = 4 the lowest. The variation of intensity of the 8300-A multiplet should be an aid in analysing this spectrum. The fluorescence and absorption spectrum are being investigated with higher-resolution instruments and at low temperatures.

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