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THE EMISSION SPECTRUM OF CALIFORNIUM

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Californium, element number 98, was discovered in 1950 by Thompson, Street, Ghiorso, and Seaborg.[1] Since then many nuclear properties[2] of its various isotopes have been studied, whereas the chemical and physical properties have only been briefly investigated.

Present spectroscopic research indicates that Cf^{+3} should be similar to Dy^{+3}, the rare earth homolog.[3] It is very likely that Cf I and Cf II will have similar electronic configurations to Dy I and Dy II, namely $5f^9\ 7s^2$ for Cf I and $5f^9\ 7s$ for Cf II. Further interest in the optical spectrum of Cf arises from the suggestion by Burbridge et al.[4] that spontaneous fission of Cf^{254} may release the predominant energy during the decay of Type I supernovae. Since spectral observations of supernovae are available,[5] curiosity impelled a comparison with a measured emission spectrum of californium.

For this work 0.4 microgram (μg) of Cf was used, since only limited quantities of Cf are available. The material was produced by neutron irradiation of Pu^{242} and was isolated from capture and fission products by ion-exchange and precipitation procedures. As a final step to remove residual

impurities, Cf was eluted from a very small Dowex-50 collodial resin bed with 6 M HCl. The fraction containing Cf was then evaporated onto 1/4-in. copper electrodes and sparked[6] in an enclosed chamber.[7] The column eluant immediately preceding the Cf was used as a blank, and any emission lines that appeared in this blank were removed from the Cf line list.

The spectra were taken on a 3-meter Eagle grating mount having a dispersion of 5.57 A/min. The wavelength region was first order from 3640 to 5040 A. A portion of the slit was covered with glass while the remaining portion was left uncovered; thus, the uncovered portion had the second order superimposed on the first order. There were no lines in the region of 2000 to 2500 A due to Cf. To determine the presence of impurities, reference spectra taken on the same instrument were compared with the Cf spectra. Only Ca and Sr appeared in appreciable quantities in the Cf sample; however, Ba, Fe, and Mg were detected. Forty-four other elements whose strong lines would have appeared in this region were not detectable. A search was made for the weak lines (in this wavelength region) of fourteen other elements and none were found. A final list of wavelengths, accurate to ± 0.1 A, of the residual lines credited to Cf are given in Table I.

A comparison between the spectral features of the supernovae IC 4182 and NGC 1003[5] and those of Cf proved fruitless regardless of any red or violet shift. Because the source environments are drastically different (on the order of 10^9 K°) it is unlikely that any similarity would occur.

Table I. Wave lengths and relative intensities of Cf line

Wave length (A)	Relative intensity
3706.4	3
3722.2	8
3724.5	4
3743.4	4
3785.6	9
3789.1	10
3844.5	2[b]
3851.6	2[b]
3893.1	9
4266.7	4
4283.8	5
4302.6	2
4307.7	3[b]
4335.2	5

[b] broad

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