Brief Reports

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Optical spectra of U^{2+}, U^{3+}, and U^{4+} ions in calcium fluoride crystals

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We report on optical spectra of single-valence U^{2+},U^{3+},U^{4+} ions in CaF_2 crystals at 10 K. The report supplements two previous papers by the author.

The physical and chemical properties of uranium ions in CaF_2 crystals have been discussed in two previously published papers of the present author.[1,2] A review of those papers indicates that no significant changes are required. However, the desirability for publication of more detailed optical transmission characteristics of the various crystal materials is apparent. This Brief Report is made to remove that deficiency (see Figs. 1–8). It should be noted that the optical-absorption spectra presented are of almost valence-pure species of each uranium ion, U^{2+}, U^{3+}, and U^{4+}. The addition of these spectral data completes the presentation of the papers,[1,2] may assist in the resolution of an old controversy,[3] and clarifies the status of many published papers involving particularly the U^{4+} ion.[4–10]

Interest in the CaF_2:U^{3+} laser has been inactive for a long time, mainly because cryogenic cooling is required for efficient operation, but it is an excellent system with very low pumping threshold. It is a likely candidate for renewed interest, because of improved cryogenic technology, and new interest in the 2.5 to 2.6 μm laser wavelengths.

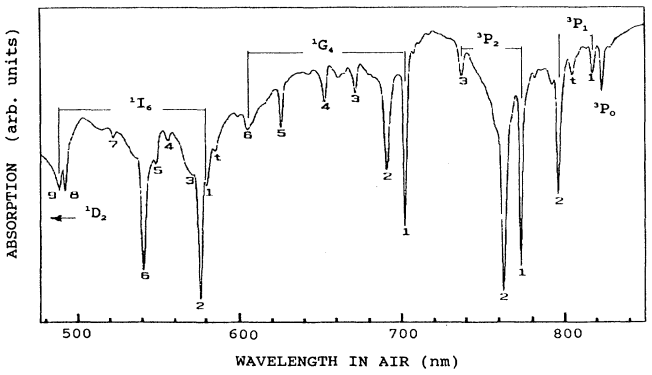

FIG. 1. The absorption of CaF_2:U^{4+} in the visible spectrum at 10 K.

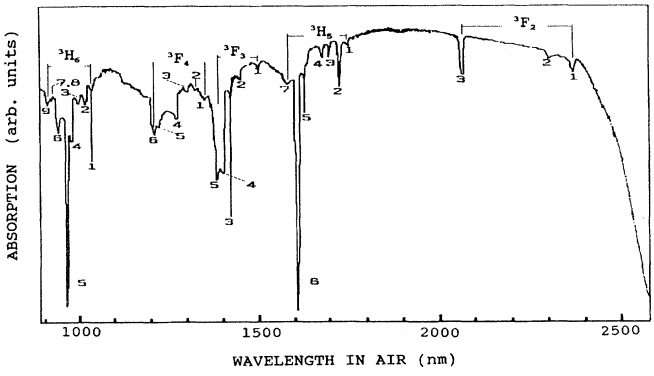

FIG. 2. The absorption of CaF_2:U^{4+} in the infrared spectrum at 10 K.

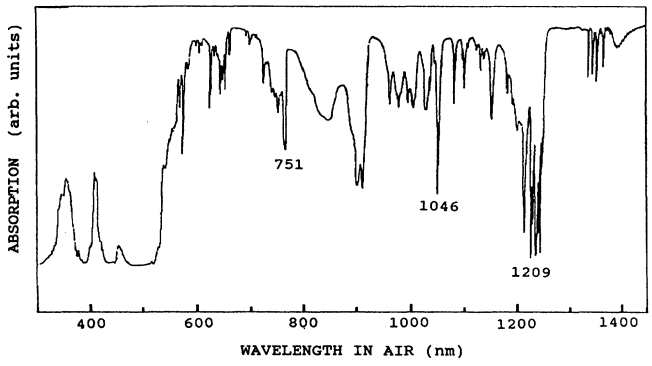

FIG. 3. The absorption of $CaF_2:U^{3+}$ in the visible spectrum at 10 K.

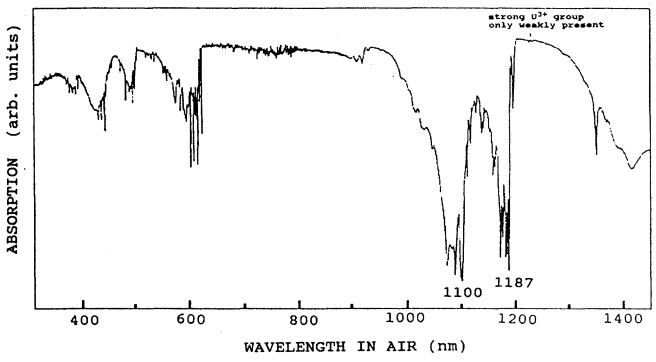

FIG. 4. The absorption of $CaF_2:U^{2+}$ in the visible spectrum at 10 K.

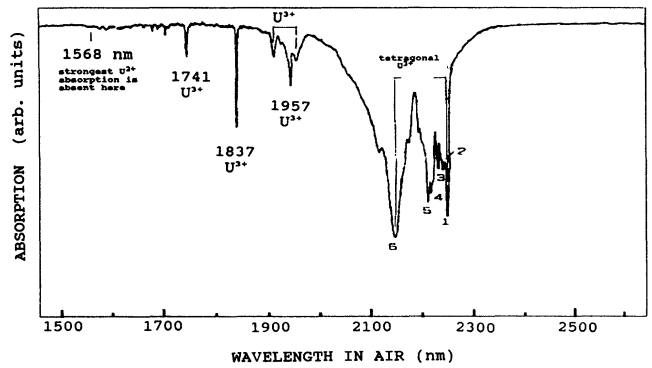

FIG. 5. The absorption of $CaF_2:U^{3+}$ in the infrared spectrum at 10 K.

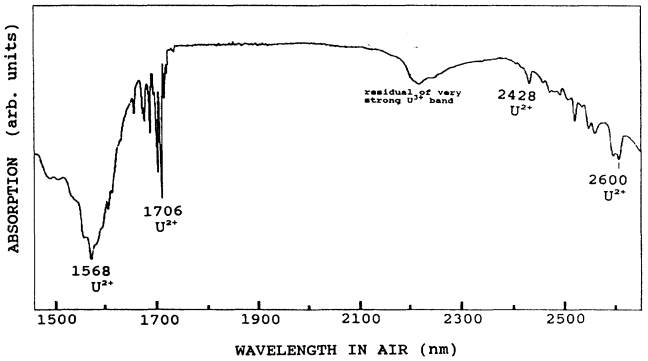

FIG. 6. The absorption of $CaF_2:U^{2+}$ in the infrared spectrum at 10 K.

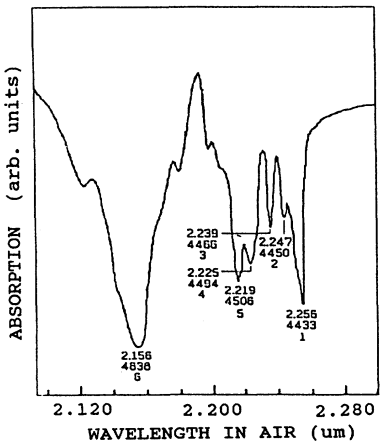

FIG. 7. The absorption of the six tetragonally sited $^4I_{11/2}$ levels of $CaF_2:U^{3+}$ at 10 K.

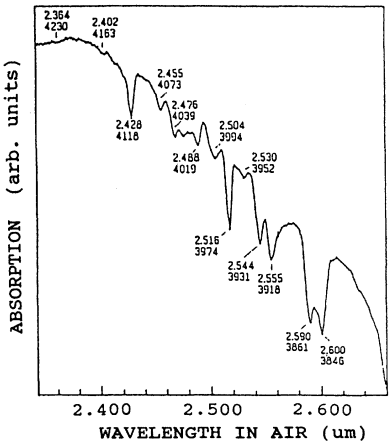

FIG. 8. The absorption of the $^5I_5$ levels of $CaF_2:U^{2+}$ at 10 K. These levels are diagrammed in Fig. 3 of Ref. 2.

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