ABSORPTION SPECTROSCOPY IN SOLIDS UNDER SHOCK COMPRESSION

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A time-resolving spectrographic streak camera system employing a pulsed (30 μsec) 12 torr xenon lamp of 10^2 cm^3 volume, into which 4,000 J is discharged, is used as a light source to measure crystal-field absorption spectra during the time interval that a strong, impact-induced, shock propagates through the sample. Transmittance data recorded for the case when the shock propagation path and light path are parallel and are oriented at 30° to the C-axis in Cr^{+3}-doped (0.05%) Al_2O_3 (ruby) have spectral and time resolutions of 8 nm and 10 nsec, respectively, over the spectral range, 400 to 600 nm. The absorption band arising from the electronic transition $^4A_{2g} \rightarrow {}^4T_{2g}$ at 554 nm, at zero-pressure is observed to continuously shift to values of 506, 506, and 502 (±10) nm as shock waves with pressures of 30.1, 44.3, and 45.7 GPa, respectively, encompass the optical path viewed within the sample. The present data imply considerably lower crystal field stabilization energies ~24000 cm^{-1}, in the 30 to 46 GPa pressure range than previously observed dynamically and predicted from a simple point charge model. Extension of present techniques to measurements in the 100 GPa regime are discussed.