

## Pressure Effects on Spectra of Tunable Laser Crystal GSGG:Cr<sup>3+</sup> I: Theory

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**Abstract:** A theory for shifts of energy spectra due to electron-phonon interaction (EPI) has been developed. Both the temperature-independent contributions and the temperature-dependent ones of acoustic branches and optical branches have been derived. It is found that the temperature-independent contributions are very important, especially at low temperature. The total pressure-induced shift (PS) of a level (or spectral line or band) is the algebraic sum of its PS without EPI and its PS due to EPI. By means of both the theory for shifts of energy spectra due to EPI and the theory for PS of energy spectra, the total PS of R<sub>1</sub> line of tunable laser crystal GSGG:Cr<sup>3+</sup> at 70 K as well as the ones of its R<sub>1</sub> line, R<sub>2</sub> line and U band at 300 K will be successfully calculated and explained in this series of papers.

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Key words: high-pressure effect, line shift, spin-orbit interaction, electron-phonon interaction, d-orbital, tunable laser crystal

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