

Photoacoustic Characterization of Natural Mineral Pyrite (FeS₂)

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A single p-type crystal of the mineral, pyrite (FeS₂), was characterized photoacoustically using the transmission detection configuration. Photoacoustic (PA) amplitude and phase spectra were measured using a specially constructed PA cell. Its construction was optimized to obtain maximal acoustical protection from the surrounding influences, so that a favorable signal-noise ratio and a flat frequency characteristic were achieved up to 6000 Hz. The PA signals were measured using an experimental setup with a semiconducting red laser (75 mW) as the optical source. The PA spectrum of a single crystal of FeS₂ was measured for samples between 450 μm and 960 μm thick.

The amplitude and phase PA spectra of the FeS₂ samples were normalized for different thicknesses and numerically analyzed. The average value of the thermal diffusivity (D_T) of FeS₂ was calculated to be 0.13×10^{-4} m²/s, the optical absorption coefficient (α) about 23500 m⁻¹ and the mobility of the minority free carriers (μ_n) about 1250 cm²/Vs. The calculated free electron mobility was much higher than the electron mobility of 230 cm²/Vs reported in the literature [1] for polycrystalline samples. The excess-carrier lifetime $\tau=85$ μs and the recombination velocities for the back and front sides $s_b=9.6$ m/s and $s_g=50$ m/s cannot be compared with any literature data as far as we know.

[1] T.A. Bither, R.J. Bouchard, W.H. Cloud, P.C. Donohue, and W.J. Siemons, *Inorg. Chem.* **7**, 2208 (1968).