

Raman Micro-Spectroscopy: A Thermal Maturity Solution Where Traditional Measurements are Impractical

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ABSTRACT

Raman micro-spectroscopy provides a "degree of graphitization" measurement of carbonaceous material that correlates well to programmed pyrolysis TMAX. The benefits of Raman micro-spectroscopy are that it is relatively low cost, rapid, non-destructive, in situ, high-resolution, repeatable, and does not require sample preparation. Raman micro-spectroscopy is therefore ideal for situations where traditional bulk analysis or destructive analysis is not feasible, undesirable, or has not provided useable results. Raman micro-spectroscopy, at 473 nm excitation wavelength, was performed on samples of known bulk thermal maturity to generate a correlation between programmed pyrolysis TMAX and the baselined, intensity- normalized G-band full-width half-maximum (fG) derived from the Raman spectra. The TMAX- fG correlation was used to determine the relative thermal maturity of various particles and samples where previous attempts with traditional methods like programmed pyrolysis, optical reflectance, and biomarkers had provided inconclusive results, or, where such traditional methods were impractical. Potential limitations to Raman micro-spectroscopy are that the resulting spectra and the parameters associated, like fG, are excitation wavelength specific, possibly instrument configuration specific (e.g. grating size), and are subject to noise from fluorescence common with low maturity samples. Additionally, the power of the excitation laser must be kept low to prevent thermal degradation of the sample. Finally, various techniques of spectral deconvolution are used in the literature (e.g. Lorentzian and Gaussian curve fitting) to obtain parameters like fG, that, especially in combination with excitation wavelength specificity, can make comparing data with literature difficult.