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April 2015

In-depth Study of Raman Spectroscopy on Carbon Black Ink as a Potential Method for Non-Destructive Dating of Ancient Manuscripts (Abstract)

Micro-Raman spectroscopy is a non-destructive light scattering technique that can be used to distinguish physical and chemical properties of materials. We have performed micro-Raman spectroscopy experiments on the black ink from Egyptian manuscripts of known provenance ranging in date from 300BCE to 1000CE. All the black ink showed the typical spectrum of carbon black ink with broad D and G bands. The D band is a forbidden Raman transition that occurs when the lattice symmetry is broken. The D band at approximately 1350cm-1 is associated with disorder, vacancies crystalline edges, etc. The G band at 1585cm-1 is a Raman allowed transition that arises from the E2g in-plane vibration of sp2 bonded carbon. These features in the Raman spectrum of carbon are assigned to the crystalline and amorphous carbon content. The carbon black spectra observed showed clear changes with the age of the ink. The significance and number of peaks to fit the Raman spectrum of carbon black is not well understood. We selected to fit our data with two, three, and four peak fits to try to extract quantitative and qualitative insight from the spectra. We found that all the parameters from our two peak fits show correlations with the age of the ink that could potentially be used to non-destructively date ink of unknown date.