File: 49

PLEAF spectroscopy of black inks and red seal inks on Chinese paintings

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Plume-Laser-Excited-Atomic-Fluorescence (PLEAF) is a soft laser/material interaction spectroscopic technique that presents advantages for cultural heritage material characterization. The PLEAF principle is based on a two-laser-pulse scheme: the first 355 nm laser pulse induces desorption of a thin layer of material (laser fluences below the damage threshold) and the second 193 nm laser pulse induces fluorescence from the multi elemental and molecular analytes in the desorbed plume. The sample stage design can accommodate samples of different size and shape. Sample preparation is not necessary.

We analyzed Chinese black inks and red seal inks on paper by means of PLEAF. We were able to detect trace elements at the ppb level with spectral averaging. Single-shot analysis gave atto-mol level mass LOD. We sampled five commercial Chinese inks that were applied on two kinds of xuan paper, ten ink/paper combinations in total. We also characterized three commercial Chinese red seal inks on xuan paper. Partial-least-square discriminant analysis unambiguously sorts the various ink-paper combinations. The sampled area is not visibly damaged even under the microscope. The degree of non-invasiveness will be further discussed.