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Conventionally accelerated and plasma-accelerated particles for studying destructive pigment darkening in artworks

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The strong focusing down of intense laser pulses in air leads to the production of plasma-accelerated low-energy electrons. These particles are emitted almost isotropically and travel with an intense photon emission, which –when impacting matter –stimulate cathodo- and luminescence. This contemporaneous luminescence emission provoked by both electrons and photon has recently been referred to as In-Air Plasma-Induced-Luminescence (In-Air-PIL). In this paper we study the In-Air-PIL spectroscopy as alternative to classical chemical and crystallographic methods employed in materials science using conventional accelerated (e.g. the Particle Induced X-Ray Emission –PIXE), and in particular in the field of Cultural Heritage. We evaluate the suitability of the suggested technique on a case study related to investigating the effect of the light aging on the darkening of five pristine yellow pigments commonly employed in Cultural Heritage artworks. Using different accelerator techniques we show that the darkening is not associated to changes in the chemical composition, neither the oxidation nor absorption of impurities, or rearranging of the morphology, but to a strong loss in crystallinity.

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