

## **PORTABLE XRD/XRF INSTRUMENTATION FOR THE STUDY OF WORKS OF ART**

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In Cultural Heritage research, truly non-invasive analytical procedures not only require that no sample is taken from the object, but also that the object does not move from its location. The transport of the object to an instrument comes at a risk of accidental damage, which translates into high insurance fees. Therefore portable instruments that are taken to the object are highly favored to conventional laboratory instruments. The typical example is XRF with the handheld analyzers that have become one of the major tools in diagnostics.

A small Portable XRD/XRF instrument, named X-Duetto, is being jointly developed by the Getty Conservation Institute and inXitu, Inc to enable non-invasive analysis of works of art. The instrument head, configured in reflection geometry, is placed on the sample using a stand or a photographic tripod, and precisely adjusted with an X-Y-Z stage and laser alignment guides. A fine X-ray beam, produced by a small copper tube and miniature slits illuminates the object at 10° incidence. A 2D CCD detector collects the X-rays scattered in an angular range of 20 to 50° 2θ, in direct detection (no-phosphor) to allow energy discrimination and enable parallel XRD and XRF measurements. A power & control unit, packaged in a separate rugged case, includes Li-ion batteries for autonomous operation in the field, a miniature computer for control of the instrument, and a wifi access point for remote operation and data download from any laptop PC. Each of the two units weights less than 10kg and can easily be transported to any remote site.

Usable XRD patterns can be obtained in as little as 5 minutes. The XRF data collected from the same spot, informs on the chemical composition of the sample and can be used for screening during phase identification with the XRD data. Several iterations of prototypes of X-Duetto have been tested on a variety of samples. The results of the most significant case studies will be presented.