

In-air broad beam ionoluminescence microscopy as a tool for rocks and stone artworks characterisation

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Received: 27 January 2012 / Revised: 11 May 2012 / Accepted: 13 May 2012 / Published online: 29 May 2012
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Abstract Broad beam ionoluminescence (IL) microscopy is a promising technique for the non-destructive characterisation of rocks and stone objects. Luminescence imaging by means of broad ion beams has been sporadically used by other authors but, to our knowledge, its potential has not yet been fully investigated, neither in geological science nor in other fields. The in-air broad beam IL microscope was developed and installed at the INFN-LABEC external microbeam in Florence. Similar to the cathodoluminescence (CL) microscope, the apparatus exploits a CCD colour camera collecting images (few square millimetres wide, with $\sim 10\text{-}\mu\text{m}$ spatial resolution) of the luminescence emitted by the sample hit by a defocused megaelectron volt (MeV) proton beam. The main differences with the well-established

and widespread CL are the possibility of working in air (no sampling or conductive coatings required) and the possibility of combining the analysis with microbeam analysis, such as, for example, $\mu\text{-IL}$ and $\mu\text{-PIXE}$ (particle-induced X-ray emission). To show the potential of the technique, IL images of thin sections of lapis lazuli are compared with those obtained by means of an in-vacuum cold CL. An application to the study of stone artworks is also reported. This technique and apparatus will provide a valuable help for interdisciplinary applications, e.g. in geological sciences and in the cultural heritage field.

Keywords Ion microprobe · Ionoluminescence microscopy · Cathodoluminescence · PIXE · Lapis lazuli · Archaeometry

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