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Upgrade of the CSIRO Nuclear Microprobe aimed at high definition PIXE imaging

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A major re-build of the CSIRO Nuclear Microprobe (NMP) in Melbourne was underway at the time of the 2012 ICNMTA conference, which aimed to exploit the construction of a purpose built Maia fluorescence detector for high definition PIXE imaging. Further refinement of the design of Maia has been necessary and the finalization of this project is very close and may be operational around the time of the ICNMTA in Italy. Hopefully, this paper will show the first data acquired using the new PIXE-Maia system. Notwithstanding Maia status, it will also feature the operation of the new data acquisition system and real-time processor, which can service 36 channels in addition to Maia and orchestrate a range of sample scanning modes on 6 axes with pixel advance based on constraints set on time, beam charge and/or counts. It will also outline features of the new Maia 384 element detector array [1,2], recently upgraded for better energy resolution, light element detection and life in the NMP vacuum chamber, as well as aspects of the reconstruction of the NMP built to accommodate Maia and precision in-vacuum stages, coaxial zoom microscope, and conventional X-ray and particle detectors. It will draw on the experience of Maia integrated into the X-ray Fluorescence Microscopy (XFM) beamline at the Australian Synchrotron [3], which can collect high definition SXRF element images of up to ~100M pixels using Maia [4]. Recent SXRF technique development of immediate application in PIXE mode includes the mapping of the depth of rare precious metal particles in geological samples, which exploits the deep penetration of X-rays or MeV protons, sample self-absorption of characteristic X-rays and the wide range of take-off angles to the Maia detector array elements to provide an imaging depth contrast and quantitative measures of individual particle depths [5].

[1] D.P. Siddons et al., AIP Conference Proceedings 705 (2004) 953.
[2] R. Kirkham et al., AIP Conference Proceedings 1234 (2010) 240-243.
[3] D. Paterson et al., AIP Conference Proceedings 1365 (2011) 219.
[4] C.G. Ryan et al., AIP Conference Proceedings 1221 (2010) 9-17.
[5] C.G. Ryan et al., Proc. SPIE 8851 (2013), doi:10.1117/12.2027195.

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