

Development of MeV Carbon-ion PIXE

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Abstract

In development of MeV heavy-ion particle induced X-ray emission (PIXE) technology which has been demonstrated to be superior to conventional light proton PIXE owing to larger cross sections, MeV carbon-ion PIXE was tested and studied for availability and cross sections. The relatively low ion energy range around 1 MeV for C-ion PIXE had never been investigated before. In the work, C-ion PIXE at ion energy around 1 MeV was firstly tested and demonstrated to be available at our 1.7-MV tandem accelerator and its beam line. In measurement of the cross sections for the MeV C-ion PIXE, 0.8, 1.0 and 1.2 MeV C-ion beams were applied to analyze materials of Si, Fe, Cu, Zn and Au and the spectra were compared with spectra of 1.0- and 2.0-MeV proton PIXE. Results showed that at the same low ion energy of 1 MeV, C-ion PIXE yields were significantly higher by orders than those of proton PIXE which were actually negligible, demonstrating the former significantly more sensitive than the latter. With the 2-MeV proton PIXE cross sections used as the reference, the MeV C-ion PIXE cross sections were calculated. An interesting trend of the cross section against the atomic number Z showed that the cross sections of MeV C-ion PIXE compared with those of proton PIXE for the analyzed materials had a transition around Cu. For lower Z the former was higher than the latter, while for higher Z the former was lower than the latter, indicating MeV C-ion PIXE more sensitive in detecting lower- Z elements. Detailed experimental and calculating methods as well as discussions are reported in the presentation.