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Study and Development of Current Transformers for Measuring of Electron Beam Pulse Current

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Beam diagnostic systems and measuring devices, which are used to verify the beam properties, are essential issues of any particle beam accelerator. In this research, we focus on study and development of a current transformer for measuring a pulse current of electron beams produced from the radio-frequency (RF) electron gun and from the linear accelerator at the Plasma and Beam Physics Research Facility, Chiang Mai University. The current transformer consists of a ferrite core with high-permeability, a conductor wire wounded around the core forming a secondary coil, and a termination resistor. The electron current that runs through the transformer acts as the current in the primary coil and it induces an inductance force in the secondary winding. Therefore, the output signal from the secondary winding can be measured and analyzed to be a current value of the electron beam. The transformer is mounted over a ceramic insulator inserted in a stainless vacuum chamber to avoid an image current, which may cancel the beam current signal. This study optimizes a number of wounding turns of the secondary coil and the resistance value of the termination resistor as well as the material type of the ferrite core. Optimal parameters of the current transformer are reported and discussed in this contribution. Even though the current transformer is a nondestructive device, the output signal from the transformer may distort due to the decay characteristic of the LR circuit. This feature is, therefore, investigated to obtain the corrected factors, which will be included in the analysis of the output signal. The final results will provide more accuracy of the measuring value of the electron pulse current. This work has been supported by the CMU Junior Research Fellowship Program, and the Department of Physics and Materials Science, Faculty of Science, Chiang Mai University.

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