DIAGNOSIS OF ELECTROMAGNETIC FIELDS AND INTERFACES BY DEFLECTOMETRY AND SCATTERING OF AN ELECTRON BEAM

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Quasi-monoenergetic electron beams with peak energies up to several hundreds of MeV can be generated by ultrafast intense lasers. Such a beam is highly collimated and has a small source size like a virtual point source, short pulse duration less than 1 ps, and a charge of a few tens of pico-Coulombs, and thus, could be used as an ultrafast probe to diagnose plasma electromagnetic fields or to radiograph a target [1]. Simulations are performed to investigate these issues.

Simulations of electron's motion in electromagnetic fields indicate that, despite of small mass and easy deflection, an electron beam with energy on the order of 100 MeV could be used to diagnose plasma electromagnetic fields via deflectometry [1]. Such a beam could also used to diagnose the magnetic reconnection structures between plasma bubbles produced by multi-laser foci.

Monte Carlo simulations are performed to investigate electron radiography of neutral materials and plasma. As the cross section of electron scattering is much higher than that of X-ray Thomson scattering, the elastic scattering of electrons could be utilized to diagnose a target interface via radiography. To assure the elastic scattering to be dominant, the energy of the electron beam is chosen to be much greater than the energy of range corresponding to the target thickness [2]. Figure 1 shows a result, the radiography of a neutral carbon-sulfur target. The target is 1-cm thick and both the C- and the S-component has a density of 2.0 g/cm^3. The incident electron beam is collimated and has an energy of 100 MeV, much greater than the energy of 1-cm range, about 3.5 MeV. At the target rear surface the transmitted electron beam shows a modulation of the electron fluence at the interface, which is caused by the elastic scattering of electrons around the C-S interface while propagating in the target.

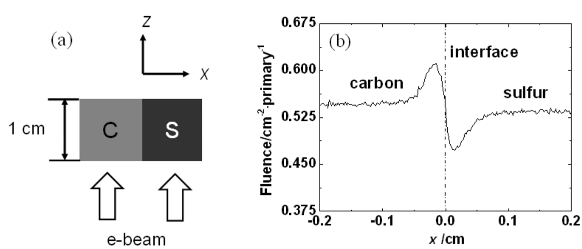

Fig.1 (a) Radiography geometry. (b) Electron fluence distribution at the target rear surface.

Similar features are found when radiographing other interfaces, such as formed by plasma density gradients or hydrodynamic instabilities. The details will be presented.

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[1] Y. Xiao *et al.,* Acta Physica Sinica 61, 234102 (2012).
[2] Y. Chen *et al.,* Acta Physica Sinica (submitted).