Opacity measurement of laser-produced high-temperature plasmas

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http://www.ile.osaka-u.ac.jp/kkatsudou/PXS.html

Radiative energy transport in plasmas strongly depends on an opacity of plasmas for soft x rays. The opacity is a critical parameter for understanding physical phenomena in laser-fusion plasmas, x-ray source plasmas, and astrophysical plasmas. High-power and -intense laser facility opened an opportunity to measure the opacity of high-temperature plasmas, which had been available only by calculations.

In this research, inner wall of a gold-cavity was heated by intense laser beams to generate and confine black-body radiation (Tr = 30-70 eV) as a heat source of plasmas. Soft x-rays emitted from the black-body cavity heat a material and produce a high-temperature plasma with uniform temperature and density profiles. The produced plasma was backlit with an another x-ray source. X rays transmitted through the plasma were measured with a grazing incidence spectrometer. The spectrum of transmitted x-rays reflects opacity structure of the plasma.

Opacity of a Sn plasma, which is expected for the next generation lithography light source, has been measured for the first time in the range from 8 to 20 nm-wavelength. The optimum conditions for producing the lithography light source plasma were experimentally and theoretically found with the use of the measured opacity.

In the future plan, opacity of an iron plasma, which relates strongly to the sun, will be performed. And also, opacity of a rare gas plasma and opacity under photo-ionizing phase will be measured. Details of our experimental results and future plan will be discussed in the presentation.

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