§19. Imaging Bolometer Calibration Data Analysis Technique Using an Iterative Scheme

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The imaging bolometer[1] is useful for measuring the radiative power from LHD plasmas. This diagnostic has been already applied to LHD[2] and JT-60U[3]. This method will be applied also to KSTAR and possibly ITER. In the bolometer using a thin metal foil, the 2D distribution of temperature is formed on the foil when the radiation is irradiated to the foil. An IR camera measures this distribution. The temporal and spatial resolutions of the measurement depend on thermal properties such as thermal conductivity and thickness of the foil, as well as radiative power intensity and photon energy. In order to calibrate the imaging bolometer, the spatial distribution of these foil properties must be determined on the foil. This can be done by comparing the results of a finite element model (FEM) of the foil with those from calibration experiments using a He-Ne laser. This absolute calibration is essential especially for using multiple imaging bolometers on LHD to perform 3D tomography on LHD.

Fig. 1 shows a flowchart of the experiment and analysis for the calibrations. A platinum foil (70 mm x 90 mm) blackened on both of its surface was used. The foil was irradiated by a He-Ne laser changing the irradiation position in vacuum, and then the spatial temperature distributions formed at each position were measured with an IR camera. The measured distributions were compared with FEM-obtained distributions using IDL software. The comparison was repeated by changing the distributions of effective foil thickness and emissivity until suitable distributions were convergently obtained.

Fig. 2 shows temperature distributions obtained by newly developed and conventional [4] calibration methods at the foil corner. The measured distribution is also shown. The temperature distribution obtained by the newly developed method reproduced the measured one at every position of the foil. In addition, the accuracy of the calibration by the newly developed methods was superior to that by the conventional one. Thus, the newly developed calibration method is promising for evaluating the distributions of effective thickness and emissivity of the foil for the calibration of the imaging bolometer.

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[4] H. Parchamy, B.J. Peterson, S. Konoshima, H. Hayashi, D.C. Seo, N. Ashikawa, Rev. Sci. Instrum. **77**, 10E515 (2006).

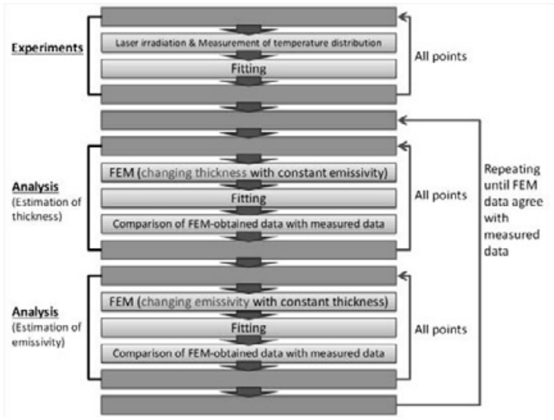

Fig. 1. Flowchart of experiment/analysis for evaluation of effective foil thickness and emissivity distributions.

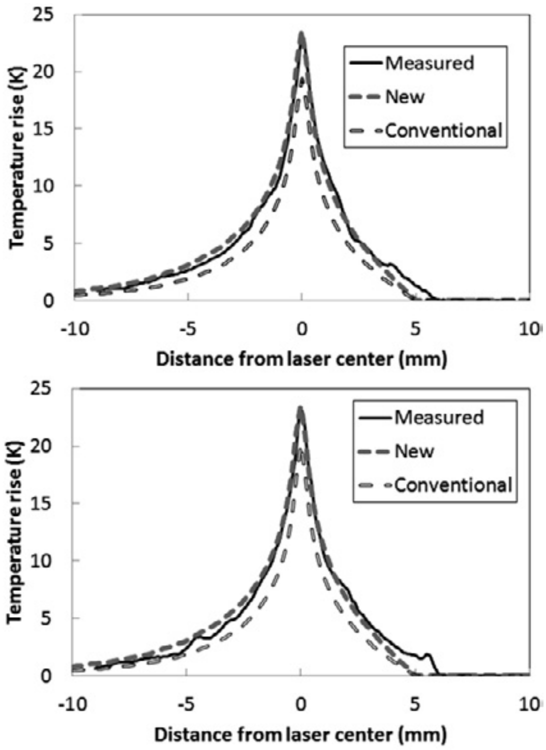

Fig. 2. Temperature distributions obtained by newly developed and conventional calibration methods at foil corner. Measured distribution is also shown.