High-throughput analysis by NIR spectroscopy for efficient bioethanol production

(Laboratory of Biomass Morphogenesis and Information, RISH, Kyoto University)

Yoshiki Horikawa, Tomoya Imai and Junji Sugiyama

Near-infrared (NIR) spectroscopy is a nondestructive, fast, and accurate measurement for analyzing chemical components on the basis of overtone and combination bands of specific functional groups. Recently, NIR spectroscopy combined with multivariate statistics has provided chemometric tools such as principal components analysis (PCA) and partial least squares (PLS) regression methods. The former is available for grouping the samples involving similar properties and identifying the specific spectral features. The latter can build the model relationships between large numbers of dependent variables containing complex variations as NIR spectra and independent variations. PLS regression has been particularly successful in creating calibration model for predicting chemical components and physical features, which allows high-throughput analysis.

We applied this technique to quantify individual chemical components of pretreated biomass alternative to the wet chemical method, which is labor-intensive, expensive, and time consuming. Furthermore, the performance of enzymatic hydrolysis for exhaustive biomass was successfully evaluated by above-mentioned chemometric approach. NIR has a great potential for rapid screening of saccharification efficiency of pretreated biomass, which would allows us to control the quality of processing toward better bioethanol production.

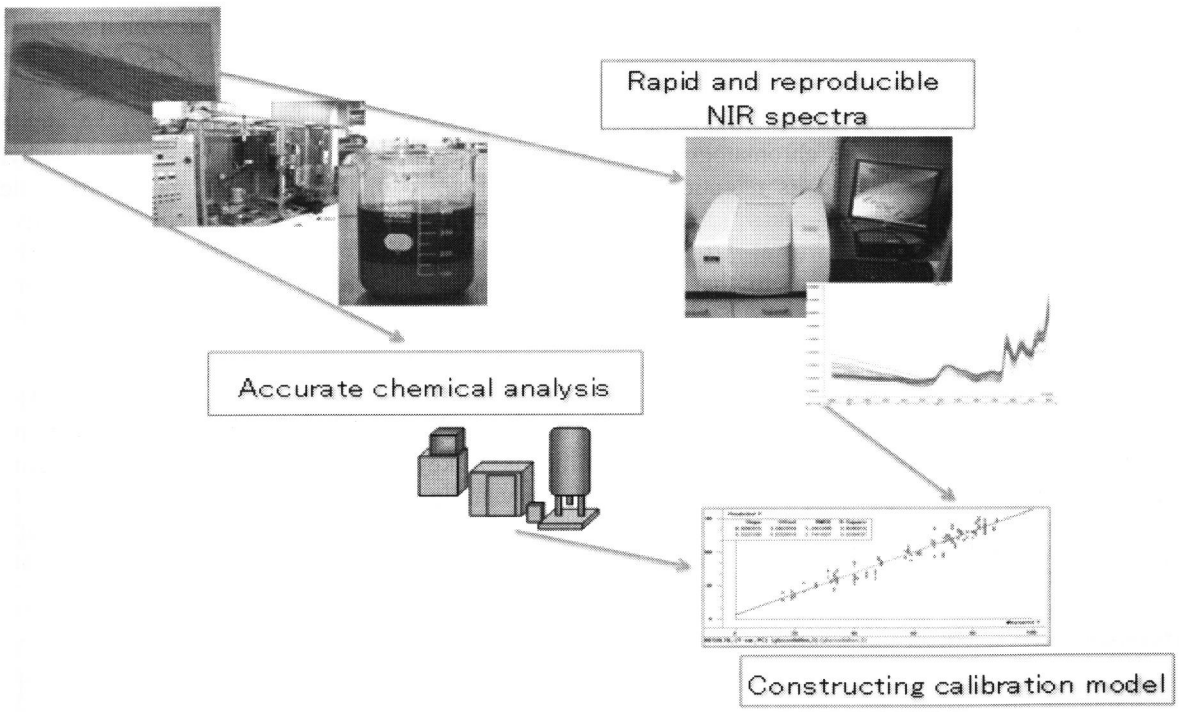

Figure Schematic illustration of the procedure to construct the calibration model between the wet chemical data and the NIR spectral data.