

## Development of Sequential Transmission Infrared Spectroscopic Microscope Incorporating Microreactor

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Transmission infrared (IR) spectroscopy is one of the excellent methods for quantitatively detecting molecular vibration with high sensitivity. The absorbance:  $A(k)$  should be calculated using the incident IR intensity or reference intensity:  $I_0(k, t_0)$  and the transmitted IR intensity of the specimen:  $I_s(k, t_s)$  by the following equation:  $A(k) = -\log(I_s(k, t_s) / I_0(k, t_0))$ , where  $k$  is wavenumber, and  $t_s$  and  $t_0$  are respective observation times. In the system having single detector, because  $I_0(k, t_0)$  and  $I_s(k, t_s)$  are measured at different times, i.e.,  $t_0 \neq t_s$ . Therefore, time-dependent fluctuation or drift of incident IR intensity cannot be ignored, in detection the time change of absorbance of a small amount of molecules, e.g. when observing a chemical reaction proceeding in aqueous solution and/or metabolism of living cells, etc., since the specimen thickness (optical path length) must be several microns or less due to the strong IR absorption of water.

In order to avoid this basic difficulty, we have developed an IR spectroscopic microscope in this study. Namely a linear array detector, in which 16 sensors were arranged, was mounted, and it was possible to measure 16 areas ( $6.25 \times 6.25 \mu\text{m}^2 \times 16$ ) at almost the same time. In addition, we fabricated and installed a microreactor having two microchannels. By simultaneously measuring the two microchannel regions with the linear array detector, it was possible to measure  $I_0(k, t_0)$  at one of the two microchannels and  $I_s(k, t_s)$  at the other side simultaneously, i.e.,  $t_0 = t_s \equiv t$ . Then, by correcting the sensitivity of each sensor using each obtained spectrum at each time of  $t$ , sequential evaluation of absorbance:  $A(k, t)$  became possible irrespective of time-dependent instability of the system. Using this newly developed infrared spectroscopic microscope, stable measurement of the absorbance of the solution could be realized.

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