

## Factors determining the stability resolution and precision of a conventional Raman spectrometer

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We verified the performance of a conventional Raman spectrometer, which is composed of a 30 cm single polychromator, a Si-based charge-coupled device (CCD) camera, and a holographic supernotch filter. For that purpose, the time change of the peak positions of Raman spectra of naphthalene and fluorescence spectra of ruby (Cr-doped Al<sub>2</sub>O<sub>3</sub>) were monitored continually. A time-dependent deviation composed of two components was observed: a monotonous drift up to 0.4 cm<sup>-1</sup> and a periodic oscillation with the range of 0.15 cm<sup>-1</sup>. The former component was stabilized at approximately 2000 s after the CCD detector was cooled, indicating that incomplete refrigeration of the CCD detector induced the drift. The latter component synchronized with the periodic oscillation of the room temperature, indicating that thermal expansion or contraction of the whole apparatus induced this oscillation. The implemental deviation is reduced when measurements are conducted using a sufficiently cooled CCD detector at a constant room temperature. Moreover, the effect of the room temperature oscillation is lowered in a spectrum acquired over a duration that is longer than one cycle of this oscillation. Applying the least-squares fitting method to carefully measured spectra enhanced the precision of the determination of the peak position to 0.05 cm<sup>-1</sup> using the spectrometer with pixel resolution of 1.5 cm<sup>-1</sup>.