Accurate absorbance measurement of a scattering material by placing the sample inside an integrating sphere

Ayaka Mori, Kyohei Yamashita, Yunosuke Tabata, Keisuke Seto, Eiji Tokunaga

Dept. of Phys., Tokyo Univ. of Sci, Tokyo
Email: 1222710@ed.tus.ac.jp

In the absorbance measurement of a scattering sample, the absorbance is often overestimated due to decrease in the transmitted light intensity by scattering. The solution to this problem is the absorbance measurement using an integrating sphere (IS) [Fig. 1]. The IS collects the scattered light in the detector, which enables the absorbance measurement that compensates for the scattering loss. With this method, the sample is usually placed at the opening [Fig. 1(a)], but backscattered light is lost. So, we placed the sample within the IS [Fig. 1(b)].

In the arrangement of Fig. 1(b), the influence of scattering in the absorbance measurement can be removed, but the measured absorbance A' does not exactly match the true absorbance A. This is because some light passes through the sample multiple times and the reflected light on the sample surface is detected. Considering these effects, we derived a correction formula that expresses A' as a function of A using several parameters experimentally determined[1]. Figure 2 shows A' vs. A of a sample P at 658 nm, which is a mixture of an absorber ($NiNO_3$ aq.) that absorbs and does not scatter the visible light and a scatterer (polystyrene microspheres) that scatters and does not absorb the visible light (658 nm is the absorption peak wavelengths of $NiNO_3$ aq.). It shows that the true absorbance of the scattering sample can be obtained from the measurement results in the arrangement of Fig. 1(b) using the proposed correction formula.

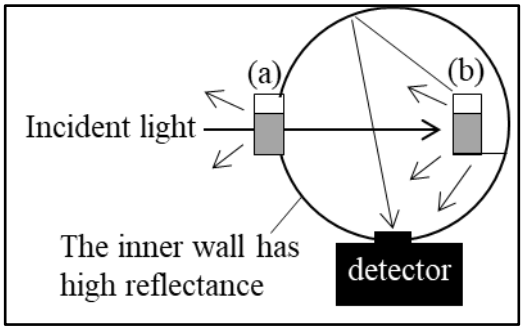

Fig 1. Absorbance Measurement using IS

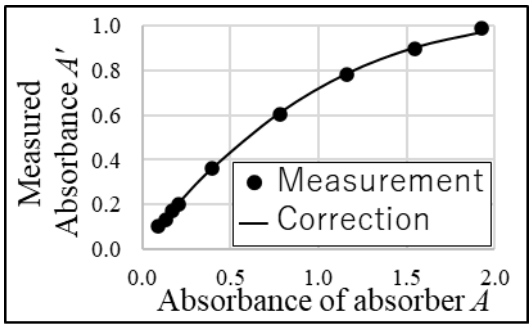

Fig 2. A' vs. A of sample P (658 nm)

[1] A. Mori et al., *Rev. Sci. Instrum.* **92**, 123103 (2021).