The Optical Rotation of Dextrose

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I. Introduction

When the linearly polarized incident light passes through a chiral molecules [1,2], it will lead to the deflection of linearly polarized light, which is the concept of optical rotation. We used the material of dextrose solution to observe it. The formula of optical rotation is defined as: $[\alpha]_\lambda^T = \alpha/cL$, where $[\alpha]_\lambda^T$ is specific rotation of dextrose; α is the deflection angle; c is the concentration of dextrose solution; L is the length of solution which the light passed by. In this study we want to prove α is proportional to c. In addition, we are trying to find out the relationship between α and T.

II. Experimental Setup

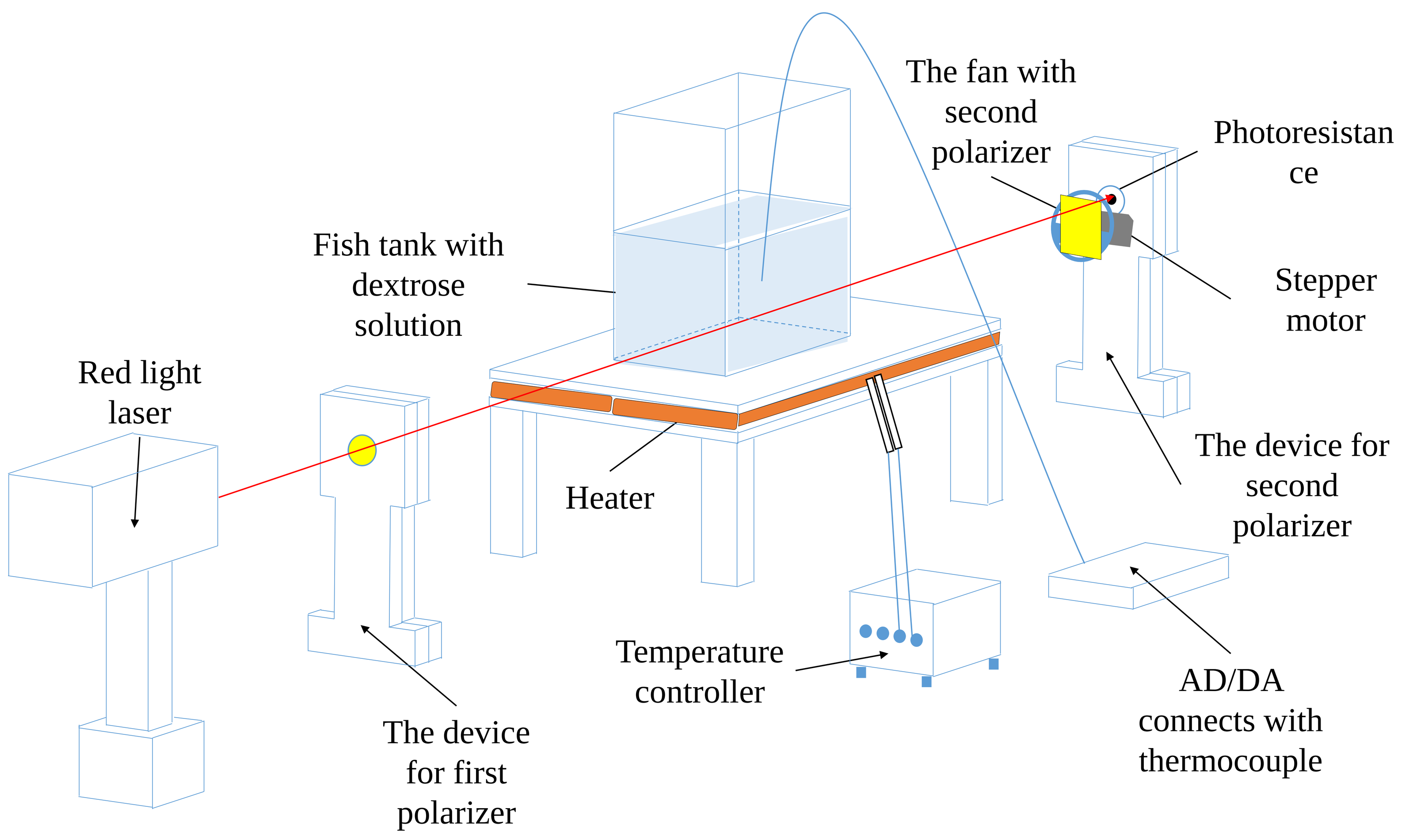

Fig. 1 The schematic diagram of the experiment device.

The red arrow means the direction of the incident light. Besides, the fan with polarizer is fixed on the stepper motor. As long as the stepper motor is rotating, it will let the fan with second polarizer rotate simultaneously. Therefore, when the incident light passed through the first polarizer, dextrose solution, and the rotating second polarizer, we could measure the light intensity as a function of rotating angle by using a photoresistance. The unit of L is decimeter (dm). L is fixed to 0.95 dm in this study.

III. Results

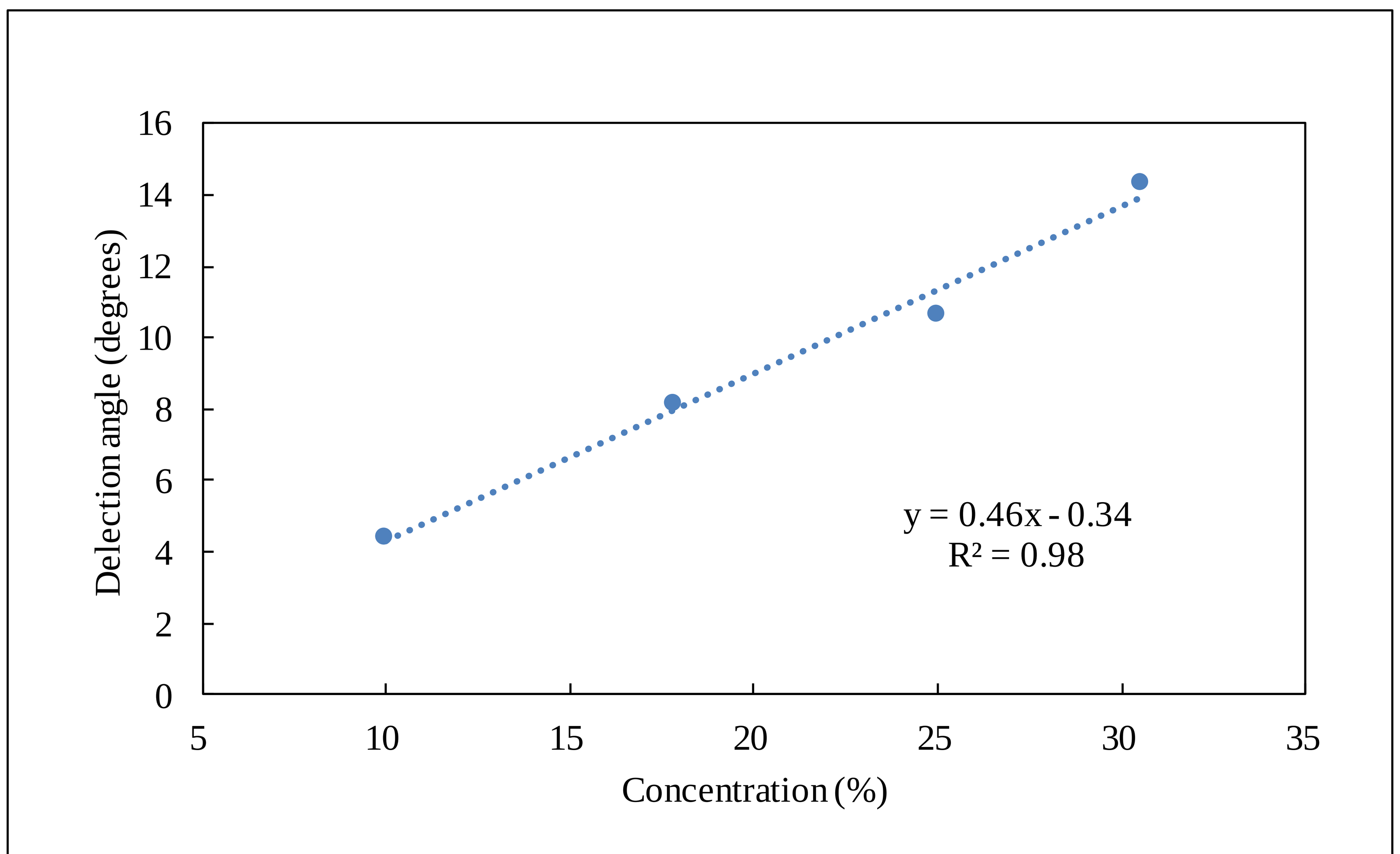

Fig. 2. The graph shows the relationship between concentration and deflection angle in 25˚C.

In Fig. 2, we can see that the value of R^2 is 0.98, which is very close to 1 and it means that we have proved of α and c are in linear relationship and the value of slope, 0.46, is equal to $L \cdot [\alpha]_{633nm}^{25°C}$ (i.e. $[\alpha]_{633nm}^{25°C}$= 48).

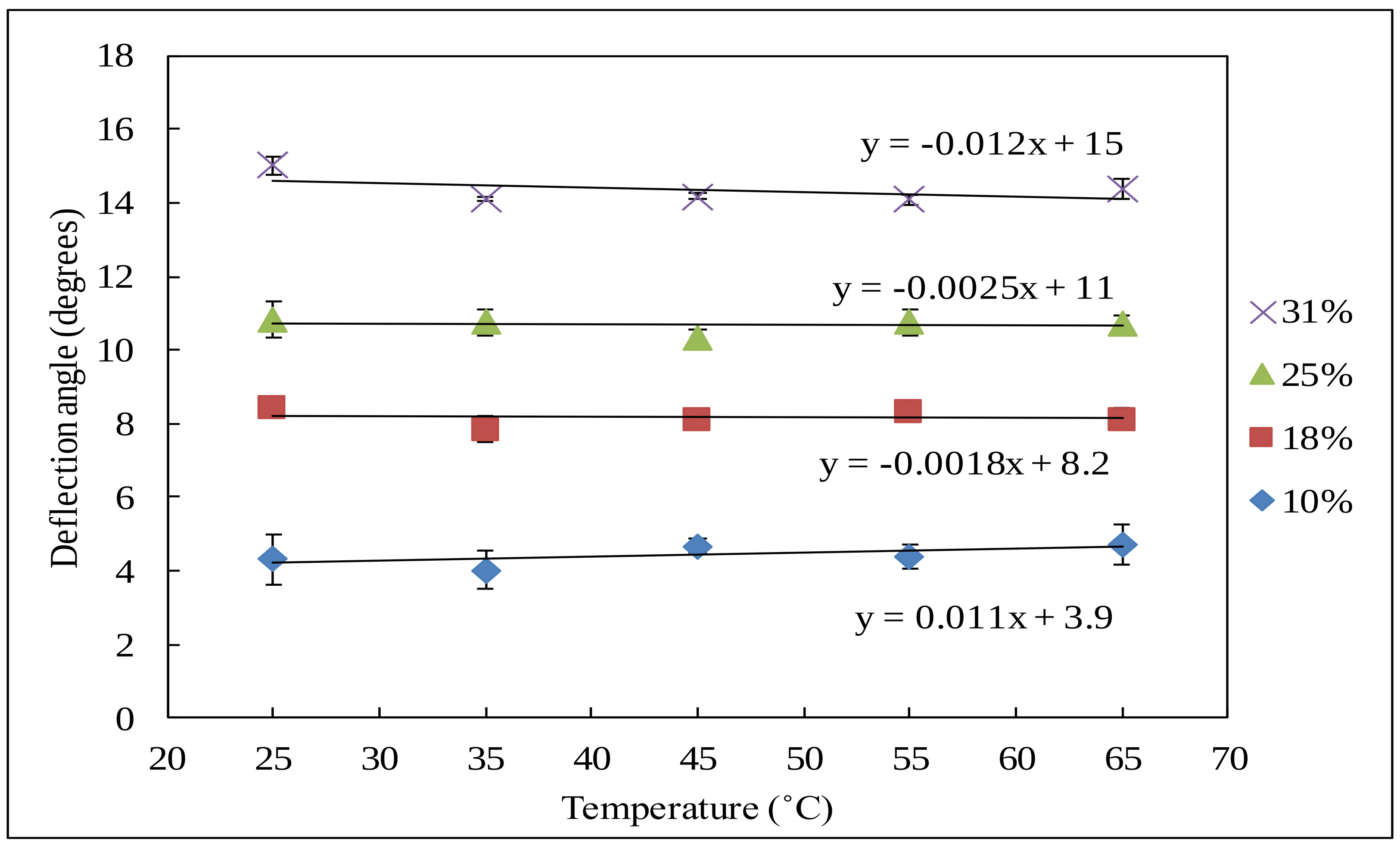

Fig. 3 The deflection angle in different concentration, depending on the temperature.

We had done experiment with four different concentrations to observe the relationship between T and α. However, the result shows precise no strong relationship between T and α (Fig. 3).

Concentration (%)	10	18	25	31
Deflection Angle (degrees)	4.4 ± 0.25	8.2 ± 0.20	11 ± 0.17	14 ± 0.35

Table 1. The deflection angle in different concentration.

From the data in Fig. 3, we still calculate the average of deflection angle in five different temperatures of four concentrations, and the number behind plus-minus sign is the standard deviation of the deflection angle data (Table 1).

IV. Discussion

According to our experimental results, we think that there are some problems which cause us cannot observe the relationship between T and α. First one is convection, when heating the dextrose solution, we neglected the convection in the solution. However, it may have the influence on the data measurement. The other is the precision of rotating angle of each step of the motor we used. Although we know that the specific rotation $[\alpha]_\lambda^T$ is related to temperature, however, when the temperature changes greatly, the change in the deflection angle is still too small for us to detect the accurate amount of change.

V. Conclusions

According to our experimental results, we can know α is proportional to c, and the $[\alpha]_{633nm}^{25°C}$ we calculated is about 48 (degree / dm). However, due to the measurement limitation of our system, we cannot precisely get the relationship between the temperature T of dextrose solution and α. The issue will be solved by using longer optical path or multi-path in further study.

VI. References

[1] L. A. E. Leal, Ab initio Study of the Optical Activity in Chiral Systems, PhD dissertation, Basque: University of the Basque Country, The Spain (2009)

[2] J. Dreiling, T. gay, Polarized Electron - Chiral Molecule Scattering Experiments, university of Nebraska-Lincoln, Behlen Laboratory of Physics. Available at: http://physics.unl.edu/ Accessed 1 May 2017