

Histamine concentration measured by a terahertz chemical microscope

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1. Introduction

The number of people with allergic diseases is increasing due to changes in our living environment and diet. Conventionally, an IgE antibody test and a histamine release test are available for allergic materials for diagnosis. These methods are minimally invasive because they can be tested only by collecting blood. However, Positive results for the IgE antibody test sometimes do not show allergen reactions. On the other hand, histamine release test directly measures histamine, which can be produced by allergen reactions so that the results can be connected to the allergic symptoms. However, few measurable allergens are available for the histamine release test.

In our group, the concentration of histamine in solution was measured by using a terahertz chemical microscope (TCM) [1]. We succeeded that it was detected by using histamine antibody previously [2]. In this study, we tried measuring histamine concentration in solution with histamine H1 receptor as the ligand, which can be expected to measure histamine with higher selectivity.

2. Experiment

TCM can measure chemical reactions on a sensing plate by measuring the terahertz wave intensity radiated from the sensing plate. The sensing plate consisted of SiO₂ and Si films on a sapphire substrate. Terahertz wave was generated by irradiating a femtosecond laser to the sensing plate from the sapphire substrate side of the sensing plate. The terahertz intensity can be connected to the electric potential on the sensing plate, which can be shifted by chemical reactions on the sensing plate [1].

In order to measure histamine, histamine H1 receptor was immobilized on the sensing plate using a covalently bonding method, followed by a blocking process to avoid nonspecific adsorption on the sensing plate. The buffer solution with three different histamine concentrations (10 μg/mL, 100 μg/mL, 1000 μg/mL) was reacted with immobilized histamine H1 receptor. Terahertz wave intensity was measured before and after reacting histamine.

3. Result

Figure 1 shows the terahertz wave intensity as a function of the concentration of histamine. Terahertz wave intensity was 0.20 ± 0.19 mV and 1.80 ± 0.53 mV for the concentration of 10 μg/mL and 100 μg/mL. Also, the intensity was 2.06 ± 0.74 mV for 1mg/mL and gradually saturated. This saturation implies that all histamine H1 receptors were reacted with the histamine.

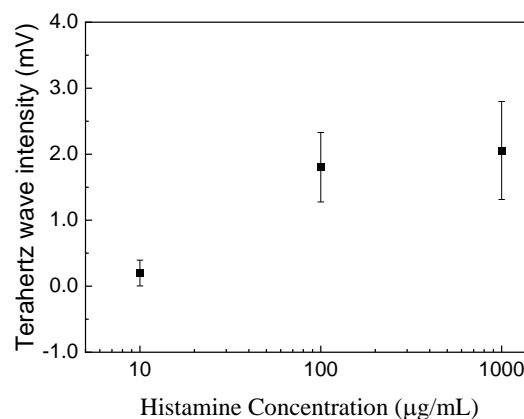


Figure 1 Change of terahertz wave intensity in histamine concentration in solution

4. Conclusion

We measured histamine concentration in solutions by using the histamine H1 receptor, which was immobilized on the sensing plate using the covalently bonding method. The results show that the concentration of the histamine in the buffer solution could be measure by the TCM.

References

- [1] T. Kiwa, et al, Appl. Opt., 47, 18, pp. 3324-3327, (2008)
- [2] K. Sato, et al, The 67th JASP Spring Meeting, 2020,