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P08

音波浮遊法を用いた溶融凝固過程の観察

Observation of melting and solidification processes using the sonic levitation method

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1. Introduction

The acoustic levitation method is a method of controlling the position of a sample by sound pressure. A stable point is created around the sample by a standing wave, and the sample is held at this stable point. If the sample is displaced from the stability point, the sound pressure makes a restoring force, and the sample levitates stably if the standing wave is maintained. The mass of a levitating sample can be as small as a few milligrams, and all kinds of samples can be levitated. In the case of a hot sample, a large temperature gradient is created around the sample. The main problem with acoustic levitation is that it is very difficult to maintain a standing wave in this temperature gradient[1)]. In this study, we investigated changes in the sound field around a heated sample and its effect on the sample position and shape.

2. Experimental method

2.1 Creation of a Sound Wave Levitation Device

In this study, a acoustic levitation device was fabricated by arranging multiple transducers in a vertical array. A concave type was fabricated using a 3D printer as the transducer array. The distance between the transducers was an integer multiple of the sound wave wavelength of 8.5 mm, and a stability point was created at the center of the transducers. A signal was sent from a function generator and boosted to 12 V by a push-pull circuit to activate the transducers. A concave transducer array was used, which can hold 37 transducers. The stand for mounting the transducers was fabricated using AutoCAD. The focal length was 93.5 mm from the center of the array.

The sound field was captured using the Schlieren method. The images acquired by the Schlieren method were band-pass filtered and frequency filtered to extract only the standing wave component.

2.2 Heating device

Sucinonitrile $(CH_2CN)_2$ was suspended at the sample position in a acoustic levitator. A halogen lamp and parabolic mirror focused on the suspended sample were used to create a non-contact heating device to observe the behavior of the suspended sucinonitrile.

3. Results＆Discussions

The sound field obtained by the Schlieren method is shown in Fig.1.

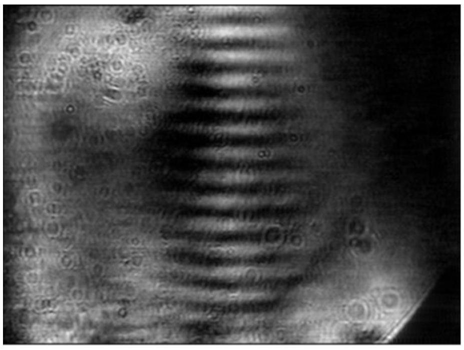

Fig1. Sound field

There is a standing wave in the center of the image with waves equally spaced. In addition, the standing waves did not change their spacing or their positions over time.

Next, the Succinonitr い ile heated and melted during levitation is shown in Fig.2.

Fig.2 Melting Succinonitrile

Levitated succinonitrile remained at the stability point without separating in air.

4. Conclusion

Visualization of the sound field was possible.
The deformation of the sound field due to temperature change of the sample was confirmed.
The sample was heated and melted without splitting.

References

1) Yutaka Abe: Control of suspended droplets by ultrasound, Journal of the Acoustical Society of Japan, Vol. 69, No. 11 (2013), pp591-596