DEVELOPMENT OF LASER SPECKLE METHOD WITH BREWSTER ANGLE IMAGING SYTEM

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1. Introduction

Brewster angle imaging is a method based on polarization with reflection at the Brewster angle. This method is generally used for imaging of single-layered films at the air-water interface. It is used for physical and morphological analysis in microbiology and for crime scene investigations in criminology (Fernsler et al., 2017).

Laser speckle contrast imaging is a simple yet effective method. That is why it is widely used in several fields, especially the screening of blood flow dynamics, biomedical applications, dermatology, neurology and endoscopic applications (Dunn, 2012)

In this project, a simple BAI system was designed to investigate and screening the time-dependent and the external magnetic field dependent changes at the air-liquid and liquid-liquid surface with the LSCI method.

2. Method

A simple Brewster angle imaging (BAI) system was designed and a laser speckle method was applied using the BAI system. The changes of magnetic nanoparticles due to external magnetic field at the air-water interface were investigated. In addition to water applications were made on liquids such as milk and tea. Mold formation on the tea and clotted cream formation on the milk were monitored by the BAI system. For these applications, the magnetic field dependent and time-dependent changes were studied by laser speckle method

3. Results

The change of nanoparticles with magnetic field was examined with laser speckle method.

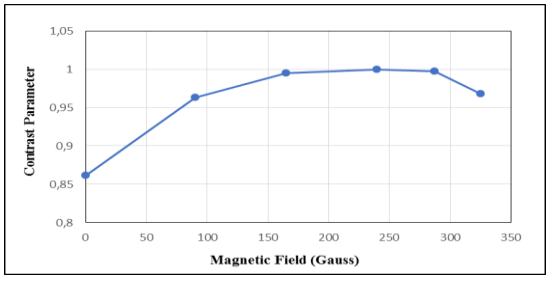

Figure 1.Variation of the contrast parameter depending on the magnetic field for magnetic liquid on water surface.

As shown in Figure (1), speckle contrast parameter increases depending on the value of magnetic field. The cause of this situation is considered as the increase of the scattering required for the formation of the speckles is much higher in the nano sizes while the aggregation due to the magnetic field may reduce scattering. Similar results are seen in literature where the speckle contrast and surface roughness are examined (Leonard and Toal, 1998).

Process of mold formation was examined with BAI system. Reflection was observed on the screen when there was no polarizer in front of the camera. When the polarizer was placed in front of the camera, it was seen that no reflection occurred. Images from the BAI system were recorded in specific time intervals. The pattern of laser speckle from the recorded camera images was studied.

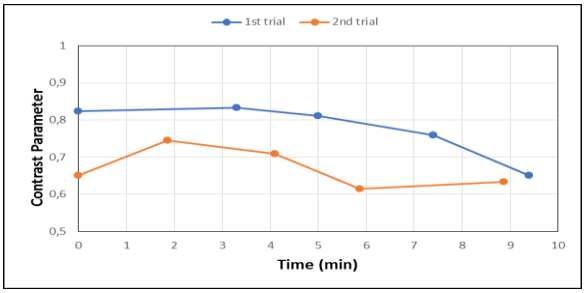

Figure 2. Time dependent of contrast parameter change for milk measurements at BAI system.

Clotted cream formation of milk was examined with BAI system. Speckle pattern analysis of recorded images was done. Figure (2) shows the time dependent change of contrast parameter. Clotted cream formation of milk decreases the contrast parameter. Similarly to the mold formation on tea, clotted cream formation of milk increases the reflection and scattering. Contrast parameter decreases related to this situation. When we take the measurement again with the 2nd experiment by clearing the resultant clotted cream formation of milk, the contrast parameter increases and two minutes later it is seen that the contrast parameter decreases as the clotted cream starts to form again.

Conclusion

Investigation of laser speckle at Brewster angle is a new method. In addition, laser speckle contrast analysis of the applications tested in the project has not been investigated before and supports the originality of the project. The application and development of this method in different fields will contribute to the literature.

References

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