Abstract Submitted for the DFD12 Meeting of The American Physical Society

Hydrodynamical entrapment of ciliates at the air-liquid interface JONATHAN FERRACCI¹, HIRONORI UENO, KEIKO NUMAYAMA-TSURUTA, Department of Biomedical Engineering, Tohoku University, YOHSUKE IMAI, Department of Bioengineering and Robotics, Tohoku University, TAKAMI YAM-AGUCHI, Department of Biomedical Engineering, Tohoku University, TAKUJI ISHIKAWA, Department of Bioengineering and Robotics, Tohoku University — We found the new phenomenon of the entrapment of ciliates at the air-water interface, though they are not trapped by a solid interface. We first characterize the behaviours of cells at the interface by comparing it to those away from interfaces. The results showed that the cell's swimming velocity is considerably reduced at the airwater interface. In order to experimentally verify the possible physiological causes of the entrapment, we observed their behaviours in absence of positive chemotaxis for oxygen and the negative geotaxis. The results illustrated that the entrapment phenomenon was not dependent on these physiological conditions. The experiments using surfactant revealed that the entrapment phenomenon was strongly affected by the velocity-stress conditions at the interface. This fact was confirmed numerically by a boundary element method, i.e. the stress-free condition at the air-liquid interface is one of the main mechanisms of the entrapment phenomenon found in the experiments. Since the entrapment phenomenon found in this study affects the cell-cell interactions and the mass transport at the interface, the knowledge obtained in this study is useful for better understanding the complex behaviours of swimming microorganisms in nature.

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Date submitted: 30 Jul 2012

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