【理学系様式３】

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論文題目	A Computational Model of Cell Migration of Fish Keratocytes			

Fish keratocytes usually show a circular shape; however, they change their shape to a half-moon shape when they begin migration. In order to understand the cell migration mechanism of keratocytes, it is important to clarify why a half-moon shape is formed. The purpose of this research is to clarify what kind of mechanism a half-moon shape is formed by physical simulation experiments considering intracellular mechanism.

Previous studies have reported that during cell migration actin molecules extend their head toward the cell membrane by actin polymerization (AP), which has been suggested as a source of the deformation of the cell membrane and propulsive force of the cell. The actin retrograde flow (ARF) that pulls the actin molecules back toward the stress fiber (SF), a bundle of actin fibers spreading from side to side of the rear part of the cell, has also been reported.

In the computer simulation of this study, the cell membrane was modeled by a network of simple particles interacting with each other and placed on a cylindrical surface as an initial condition. Each particle of the membrane was assumed to receive elastic force from neighboring particles and repulsive force from actin molecules. Actin molecules are initially zero length rods and are assumed to polymerize in random directions. The actin molecule in the initial state was arranged so as to be a half donut shape. AP and depolymerization were expressed by one-end stochastic extension and contraction respectively. As the effect of ARF, actin molecules were assumed to move toward the SF stochastically.

As a result, the actin molecule aggregated in a half-shape under the above conditions that the polymerization direction of actin molecule was controlled by ARF and became perpendicular to the cell membrane. Actin molecules could not aggregate a half-moon shape when conditions were changed, such as eliminating ARF and changing the ARF reference point to a point other than SF.