Numerical Understanding of Spot Dynamics Arising in a Mathematical Model of Camphor Motion

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Abstract: From the mathematical viewpoint, we study the self-motion of camphor disk at a water surface. We propose the mathematical model for the motion of camphor disk consisting of one partial differential equation and one ordinary differential equation, and numerically investigate camphor's motion. Moreover, we reduce an ODE system from the original model, and study the interaction phenomenon of camphor disks.

The self-motion of camphor disk at an air/water interface has been studied experimentally from the dissipation of chemical energy under isothermal conditions. The driving force of this motion is the difference in the surface tension around the camphor disk because the camphor molecular layer diffused from the disk decreases the surface tension at the air/water interface. We have observed in a experiment the following interesting behaviors when the velocity of camphor disk is very slow: (1) two approaching camphor disks never collide, that is, they reflect before collision, (2) one camphor disk keeps moving at the water surface without colliding with the wall. These phenomena cannot be explained only by the mechanism of driving force. We will try to understand these phenomena theoretically by using our ODE model describing the motion of camphor disk.

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