Microscopic thermohydraulic behavior of a three-phase contact line governing quenching behavior

Yutaro UMEHARA

Department of Mechanical Engineering, Graduate school of Engineering, Kyushu university, 744 Motooka, Nishi Ward, Fukuoka 819-0395, Japan
International Institute for Carbon-Neutral Energy Research, Kyushu University, 744 Motooka, Nishi Ward, Fukuoka 819-0395, Japan

As the boiling phenomenon shows high heat transfer rate due to the phase change of the liquid, the boiling phenomenon is widely used for the cooling technique in various industrial fields. For example, the quenching of the alloy to improve the strength and emergency cooling of the nuclear power plants. Although the boiling phenomenon is useful for the cooling techniques, the mechanism of the high heat transfer rate is still unknown. In particular, the mechanism of the quenching phenomenon, which cools down the high temperature objects remains unsolved due to the complex behavior. This study investigates the mechanism of the quenching phenomenon by focusing the microscopic unsteady behavior of the three-phase interface. It is revealed that the microscopic unsteady behavior was dominated by the boiling bubble size. Previous researches cannot observe the microscopic boiling heat transfer condition due to the limitation of the experimental method. Existed heat transfer model was assumed to match the experimental result without phenomenological observation, so these models have the limitation of the applicability. On the other hand, since the current research defined the new heat transfer model based on the actual boiling heat transfer phenomenon, this new heat transfer model can be applied to the wide range. It is expected that this new model improves the accuracy of the design in various industrial fields.