

**Title** Numerical simulation of flow of near-critical fluids

**Speaker** Prof. Gustav Amberg  
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**Place** I<sup>2</sup>CNER Hall, Ito campus, Kyushu University

### Abstract

In designing microfluidic systems, fluid dynamics becomes a key element. Fluid dynamics in microsystems, microfluidics, has grown rapidly as a research area over the last decade, driven by the increasing possibilities to design and build microsystems. The use of near critical and supercritical fluids in microsystems presents additional advantages that can be explored.

In order to design microsystems for supercritical fluids, the fluids dynamics of small volumes of such fluids needs to be understood, and sufficiently accurate modelling and simulations should be available. In microsystems viscous forces and various surface forces, notably surface tension and wetting, dominate. Also multiphase flow and phase change will have other characteristics in microsystems. Using near critical fluids there are also large density variations, and possible phase change. Success in designing supercritical microfluidic systems will depend on how these phenomena can be understood and exploited.

Single component near-critical and supercritical fluids can be described reasonably well using the van der Waals equation of state. This can be combined with a diffuse interface modeling approach, in which the density of the fluid is the primary variable, and surface energies are incorporated via gradient terms in the thermodynamical description of the system. This description allows liquid-vapor phase change near the critical point, and the transition to a supercritical state, in a natural way. The flow in terms of density and velocity fields are computed as a function of time.

We present numerical simulations of a Van der Waals fluid based on a diffuse interface method. Some flows of a supercritical or near-critical fluid, typical of microsystems are presented. One case is boiling and evaporation on a solid surface in a near critical state, as may be expected in a microsystem using critical fluids.

### About the Speaker

Prof. Gustav Amberg was born in Hallstahammar, Sweden, in 1957. He received M Sc degree in technical physics and PhD degree in fluid mechanics in 1982 and 1986, respectively. He is currently professor of fluid mechanics, and Vice president for faculty development and gender equity at KTH in Stockholm, Sweden. He works on modeling of phenomena involving fluid flows, phase change, surface tension effects, wetting, and other two-phase flows.

**Host:** Professor Yasuyuki Takata

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