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Physics of Thin Liquid Films

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12.1 Introduction

Various aspects of fluid mechanics in microelectromechanical systems (MEMS), such as flows in micro-configurations, flow transducers, and flow control by microsystems were reviewed by Ho and Tai (1998). However, the issue of thin liquid films and their dynamics in the context of microelectromechanical systems was not included in the scope of that important work. This chapter intends to fill this gap.

Thin liquid films are encountered in a variety of phenomena and technological applications [Myers, 1998]. On large scale they emerge in geophysics as gravity currents under water or as lava flows [Huppert and Simpson, 1980; Huppert, 1982]. On the engineering scale liquid films serve in heat and mass transfer processes to control fluxes and to protect surfaces, and their various applications arise in paints, coatings, and adhesives. They also occur in foams [Schramm, 1994; Prud'homme and Khan, 1996], emulsions [Ivanov, 1988; Edwards et al., 1991], and detergency [Adamson, 1990]. In biological applications they appear as membranes, as linings of mammalian lungs [Grotberg, 1994], or as tear films in the eye [Sharma and Ruckenstein, 1986]. On the microscale in MEMS, thin liquid films are used to produce insulating coating of solid surfaces, to form stable liquid bridges at specified locations, to create networks of microchannels on patterned microchips [Herminghaus et al., 1999, 2000], and to design fluid micro-reactors [Ichimura et al., 2000].

Thin Liquid Films

Puja Mehta

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