360a Vapor Phase Lubrication for Mems Devices

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Lubrication is perhaps one of the greatest challenges facing the development of practical, viable MEMS devices with surfaces in sliding contact. Liquid lubricants are not viable candidates because miniature devices cannot develop sufficient power to viscosity. Solid lubricants can be used but solid films ultimately wear and fail. One needs a lubrication mechanism that allows for replenishment of the lubricant film without the need for using liquids as the transport mechanism.

Vapor lubrication has been proposed in the past as a means for providing effective lubrication to MEMS devices. The applicability of vapor lubrication to MEMS requires that lubricant vapor be transported through long, narrow channels having very high aspect ratios. This lubricant is being adsorbed and consumed on the surfaces of the channel. Whether diffusion alone is sufficient to allow vapor lubrication of MEMS devices is not obvious and it is certain that for sufficiently high wear rates the lubricant transport mechanism will limit the lifetime of these devices. We have modeled this problem for diffusive vapor transport down a long narrow channel, coupled with lubricant adsorption and reaction on the walls of the device. The model predicts that for vapor lubricants with reasonable vapor pressures (> 1 Torr) diffusive vapor transport is sufficient to support lubrication of MEMS devices under conditions in which the wear rates are as high as 1 monolayer per second.