The meniscus region of a thin film is known to have high heat transfer properties due to high evaporation rates and activation of latent heat. The region known as the thin film meniscus ($\delta_{\text{film}} \leq 2 \, \mu \text{m}$) can account for more than half of the total heat transfer of a droplet or film. This study focuses on the potential elongation and curvature amplification of the thin film meniscus region by the implementation of a layer of high hydrogen bonding (hydrogel) film on which the liquid meniscus is built. Forced wetting via liquid propagation though this hydrogel layer in the radial direction increases the surface area of the film. By analyzing the mass flux of liquid lost through evaporation and using both spectroscopic and optical methods to obtain the curvature of the film, relationships between hydrogel thickness and the resulting mass flux were made. Isothermal and steady state assumptions were used to relate hydrogel thickness layers to meniscus curvature, evaporative mass flux, and overall heat transfer coefficients. The experimental results demonstrate, for the first time, the heat transfer properties of a thin film can be manipulated by the addition of a hydrogel layer beneath a partially wetting liquid film. These results are promising toward advancements in heat piping and high heat flux cooling systems for micro electronic devices.

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The public is welcome to attend.