Abstract Submitted
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Lubrication model for vapor absorption into hygroscopic liquid desiccant droplets[1] ZHENYING WANG, Kyushu University, GEORGE KARAPETSAS, Aristotle University of Thessaloniki, PRASHANT VALLURI, ADAM WILLIAMS, University of Edinburgh, KHELLIL SEFIANE, Kyushu University; University of Edinburgh, YASUYUKI TAKATA, Kyushu University — Liquid desiccant is a hygroscopic aqueous solution widely used in dehumidification processes. In this work, we develop a lubrication type model to describe the vapor absorption process into hygroscopic liquid desiccant droplets. Typically, the mass diffusion at the liquid phase is 10^3 - 10^4 times lower than that at the gas phase, therefore we consider a liquid-side model to capture dominant mechanisms. We consider a thin axisymmetric droplet on a hydrophilic substrate which is initially in a thermal-equilibrium state. A precursor film is assumed to exist in front of the contact line, which permits contact line movement avoiding the singularity near the contact line. The absorptive mass flux is approximated combining the Hertz-Knudsen equation and the vapour-liquid thermodynamic equilibrium relationships across the interface. The simulation results predict the evolution of droplet profile in a wide range of air conditions. In the case of vapor desorption, the model indicates the formation of thin film in front of the triple contact line along with water depletion, and provides a plausible explanation for the radiating dendritic crystal patterns that form during the crystallization process of aqueous solution droplets (*Shahidzadeh-Bonn et al. 2008; Hadj-Achour and Brutin, 2014*). In the case of vapor absorption, the model explains the droplet spreading along with water uptake, and indicates the important role of hysteresis force on contact line motion.

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