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Lubrication analysis of the nanometric coating film deposited during gravure printing UMUT CEYHAN, RUNGROT KITSOMBOONLOHA, S.J.S. MORRIS, VIVEK SUBRAMANIAN, University of California, Berkeley — We report the importance of doctor blade-tip's geometry and wettability on the formation of coating film of thickness 1-10 nm after wiping of the excess ink used for gravure printing of electronics. Several authors have worked on the blade coating problem, addressing elastohydrodynamic effects; however, the coating film deposited during gravure printing is about 3 orders of magnitude thinner than micrometer scale created in blade coating. The blade-tip radius is consequently large compared with the film and gap thickness, allowing the blade tip to be approximated by a parabola. Hydrodynamic forces are concentrated within this inner region. In the gap entry, streamlines converge making the pressure large and positive; downstream, streamlines diverge making pressure large, but negative. This large negative pressure affects the coating film thickness by tending to draw the meniscus back into the narrow gap. Gap thickness and coating film thickness are determined as part of the solution of a free-boundary problem: we couple lubrication analysis of the gap flow in the gap to Landau-Levich analysis of the film flow. The resultant hydrodynamic force and couple exerted within the inner region are compared with those exerted on the outer portion of the blade and parameters affecting the solution of the problem on the coating film formation are examined in detail.

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