Abstract Submitted
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Reactive thin film flows over spinning discs[1] KUN ZHAO, ALEX WRAY, JUNFENG YANG, OMAR MATAR, Imperial College London — We consider the dynamics of a thin film flowing over a spinning disc in the presence of a chemical reaction, and associated heat and mass transfer. We use a boundary-layer approximation in conjunction with the Karman-Polhausen approximation for the velocity distribution in the film to derive a set of coupled one-dimensional evolution equations for the film thickness, radial and azimuthal flow rates, concentration of the reagents and products, and temperature. These highly nonlinear partial differential equations are solved numerically to reveal the formation of large-amplitude waves that travel from the disc inlet to its periphery. The influence of these waves on the concentration and temperature profiles is analysed for a wide range of system parameters: the Damkohler and Schmidt numbers, the thermal Peclet numbers, and the dimensionless disc radius (a surrogate for the Eckman number). It is shown that these waves lead to significant enhancement of the rates of heat and mass transfer associated with the reactive flow; these are measured by tracking the temporal evolution of local and spatially-averaged Nusselt and Sherwood numbers, respectively.

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