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RAYLEIGH – TAYLOR INSTABILITY IN ELECTROHYDRODYNAMICS BOUNDED BY ROUGH SURFACE IN THE PRESENCE OF AN ELECTRIC FIELD

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The effects of slip due to roughness of nanostructured silicon, transverse time invariant but space variant electric field due to embedded electrodes and surface tension due to free surface on Rayleigh – Taylor instability (RTI) in electrohydrodynamics are investigated using a linear stability analysis. A simple theory based on considering a rough nanostructured silicon interface bounding a light poorly conducting liquid is proposed to find an analytical expression for the growth rate *n* of RTI, in the presence of suitably strong of electric field, in the form $n = n_c - \ell \beta_1 V_s$

where $n_c = \frac{\ell^2}{3}\left(1 - \frac{\ell^2}{B}\right)$ is the classical growth rate in the absence of both electric field and roughness of the substrate, $V_s = \ell\left[1 \pm \Delta \frac{(\beta_1 - 1)}{3\beta_1}\right] - \frac{\ell^3}{B}$ is the normal velocity, Δ represents the effect of electric field, β_1 the slip coefficient, ℓ the wave number, B the Bond number and ± will depend on whether the electric field is in the direction of gravity or opposing its direction. It is shown that the combined effect of electric field and roughness of the substrate is to reduce the growth rate of RTI considerably over the value it would have in the classical case.

Key words: electrohydrodynamic RTI, rough surface, electric field.

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