

Analysis on thin film equations with van der Waals force

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Abstract: We consider the singular elliptic equations modeling thin films with van der Waals and Born repulsion forces which leads to the elliptic problem

$$(1) \quad \begin{cases} \Delta h = \frac{1}{\alpha} h^{-\alpha} \left(1 - \left(\frac{\varepsilon}{h}\right)^\beta\right) - p & \text{in } \Omega, \\ \frac{\partial h}{\partial \nu} = 0 & \text{on } \partial\Omega, \end{cases}$$

where the thickness h is an unknown nonnegative function and the pressure p is an unknown constant. Here $\alpha > 1$, $\beta > 0$, $\varepsilon \geq 0$ are given physical constants.

We will discuss various solutions when $\varepsilon > 0$ and its singular limit as $\varepsilon \rightarrow 0$. We will also discuss steady states when $\varepsilon = 0$.