

From microscopic to macroscopic model for the growth of bacteria micro-colony

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Bacteria are abundant organisms that participate in many processes occurring in medicine, agriculture, ecology, industry. Starting from a single organism, they quickly develop into organized micro-colonies and bio-films. The formation of microcolonies, although widely studied over the past decade, is still poorly understood. We will first consider a microscopic model where each bacterium is modeled by a spherocylinder and where the bacteria interact through non-overlapping constraints. By taking into account the asymmetry of the poles of the bacteria, the model reproduces the mechanical characteristics of the growth of micro-colonies, and this without implementing either attraction or adhesion. Then we present a formal derivation of the micro-macro limit of this system and study the resulting model. Lastly we rigorously derive an incompressible limit for this type of model toward a Hele-Shaw type free boundary model.