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Universality of cauliflower-like fronts: from nanoscale thin films to macroscopic plants

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Abstract-

Chemical vapor deposition (CVD) is a widely used technique to grow solid materials with accurate control of layer thickness and composition. Under mass-transport-limited conditions, the surface of thin films thus produced grows in an unstable fashion, developing a typical motif that resembles the familiar surface of a cauliflower plant. Through experiments on CVD production of amorphous hydrogenated carbon films leading to cauliflower-like fronts, we provide a quantitative assessment of a continuum description of CVD interface growth. As a result, we identify non-locality, non-conservation and randomness as the main general mechanisms controlling the formation of these ubiquitous shapes.We also show that the surfaces of actual cauliflower plants and combustion fronts obey the same scaling laws, proving the validity of the theory over seven orders of magnitude in length scales. Thus, a theoretical justification is provided, which had remained elusive so far, for the remarkable similarity between the textures of surfaces found for systems that differ widely in physical nature and typical scales.

Index Terms-

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