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Cooling of hot bubbles by surface texture during the boiling crisis[1] NAVDEEP DHILLON, JACOPO BUONGIORNO, KRIPA VARANASI, Massachusetts Inst of Tech-MIT — We report the existence of maxima in critical heat flux (CHF) enhancement for pool boiling on textured hydrophilic surfaces and reveal the interaction mechanism between bubbles and surface texture that governs the boiling crisis phenomenon. Boiling is a process of fundamental importance in many engineering and industrial applications but the maximum heat flux that can be absorbed by the boiling liquid (or CHF) is limited by the boiling crisis. Enhancing the CHF of industrial boilers by surface texturing can lead to substantial energy savings and reduction in greenhouse gas emissions on a global scale. However, the fundamental mechanisms behind this enhancement are not well understood, with some previous studies indicating that CHF should increase monotonically with increasing texture density. However, using pool boiling experiments on a parametrically designed set of plain and nano-textured micropillar surfaces, we show that there is an optimum intermediate texture density that maximizes CHF and further that the length scale of this texture is of fundamental significance. Using imbibition experiments and high-speed optical and infrared imaging, we reveal the fundamental mechanisms governing the CHF enhancement maxima in boiling crisis.

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