

# Central spot pattern formation under enhanced Marangoni effect

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## Abstract

“Coffee-ring” is the common residual pattern left by a colloidal droplet with pinned contact line, during which the evaporation induced capillary flow play a key role. However, if the evaporation induced Marangoni flow is obvious, particles can also be carried to move inward and aggregate at the center part of the droplet. In this study, a three-dimensional (3D) Monte Carlo method has been developed to simulate the different dried patterns under both weak and strong Marangoni effect. The particle motion is controlled by calculating the probabilities of six moving directions using the analytical solution of the flow. The strength of the Marangoni effect is controlled by a function  $f$  and the possibility of particle-particle aggregation is set to a low value. The results show that by enhancing the Marangoni flow in the drying droplet, the final dried residuals can be transformed from “coffee-ring” only pattern to a pattern with a central spot inside a thin ring. The results are similar to the deposited patterns under vacuum enhanced Marangoni flow.

**Keywords:** Monte Carlo method, Marangoni flow, central spot