# Formation of petal-like concentric precipitation patterns by continuous injection of dye solution into filter paper associated with solvent evaporation

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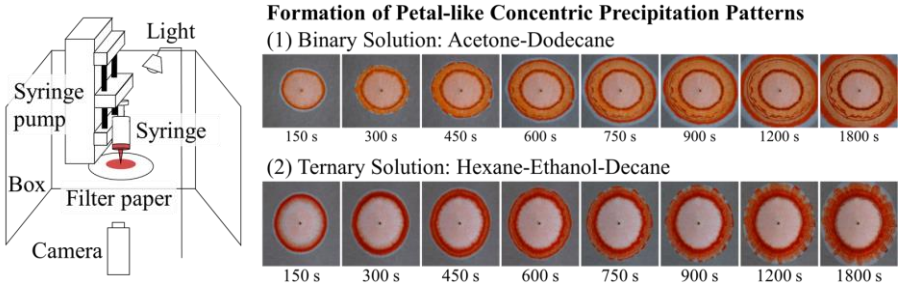
**Keywords**: Precipitation Pattern; Petal-like Pattern; Concentric Pattern; Permeation Associated with Evaporation; Supersaturation Theory

Temporal, spatial, and spatio-temporal patterns are spontaneously generated in far-from-equilibrium system, and they are called dissipative structure.[1] Liesegang ring, a concentric precipitation pattern, has been studied as the example of dissipative structure since its discovery about 150 years ago.[2] In the present study, attempts were made to generate similar concentric precipitation pattern by different mechanisms.

The system we have employed was continuous injection of mixed solvent solution of dye into filter paper associated with solvent evaporation from its surface. Red dye, Sudan III, was dissolved in binary solution of acetone and dodecane and ternary solution of hexane, ethanol, and decane. These solutions were injected into the circler filter paper from its center at a constant flow rate. Since the experiments were conducted in an open environment, the dye concentration in the solution increased with the solvents evaporation to lead to the precipitation.

In both cases, concentric precipitation patterns similar to the Liesegang ring were found to be generated. A theoretical model was proposed for reproducing the precipitation pattern based on the supersaturation theory for the Liesegang ring and Richards' equation for the unsaturated permeation. The model explained that the concentric precipitation pattern was generated by the repetition of intermittent precipitation. The concentric precipitation rings were radially segmented to form petal-like patterns. Protuberance of liquid droplets were found to be generated at the periphery of the liquid permeated into the filter paper, and the droplet formation was due to Marangoni contraction.[3] The formation of the petal-like structure was found to be associated with the continuous formation and collapsing of the droplets.

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