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Colloidal assembly in confinement

JUNWEI WANG[1], MBAH CHRAMEH FRUH[2], MICHAEL ENGEL[2], NICOLAS VOGEL[1,*]

[1] Institute of Particle Technology, Friedrich Alexander University Erlangen-Nürnberg
[2] Institute of Multiscale Modelling, Friedrich Alexander University Erlangen-Nürnberg
*e-mail: nicolas.vogel@fau.de

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The spontaneous organization of individual building blocks into ordered structures is extensively used in nature and found at all length scales, from crystallization processes, via composite materials, to living cells constituting complex tissue. Understanding the relationship between building blocks, environmental conditions, and resulting structure is of fundamental importance for controlling materials properties.

Confining elements imposed upon the self-organizing particles can significantly alter the assembly process and may lead to entirely different colloidal crystals. Especially interesting confinements are emulsion droplets that prevent the formation of periodic structures by introducing boundaries and curvature.

Depending on the drying conditions, such confined assembly processes can lead spherical colloidal crystals with ordered exterior regions and a high amount of disorder in the core region [1] or create very highly ordered structures with symmetries deviating from the typical face-centered cubic packing typically observed for colloidal crystals.

Here, we explore the rich wealth of available crystal structures and symmetries and create a phase diagram of observed crystal phases in dependence of the number of colloidal particles within the confinement and support our model by event-driven molecular dynamics simulations of hard-spheres in a spherical confinement.

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