Supporting information for

Order-disorder transition in soft and deformable particle assembly with dynamic size-dispersity in two dimensions

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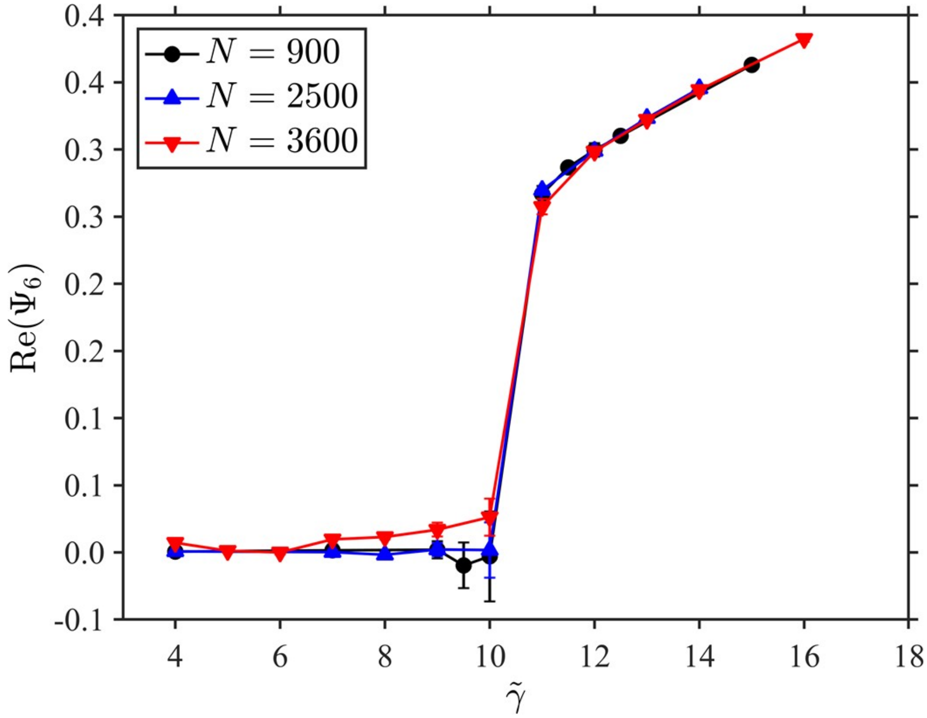

Fig. S1 Mean global orientational order parameter (see eqn (5) in the main text) with $\tilde{\gamma}$ at $\tilde{k} = 100$ for three different system sizes. The system size shows negligible effect on the system behavior.

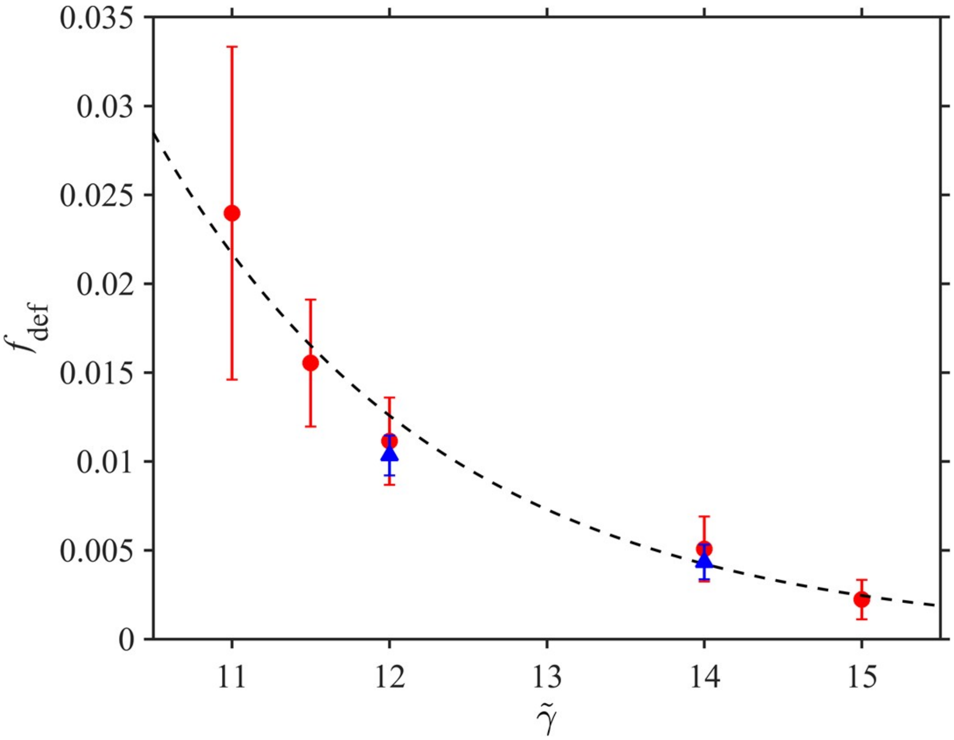

Fig. S2 Concentration of topological defects f_{def}, estimated from the fraction of non-hexagonal particles, with $\tilde{\gamma}$ for $\tilde{k} = 100$ system (see also Fig. 6 in the main text). The red symbols correspond to simulations initialized from a perfect hexagonal lattice, while the blue symbols start from the final configuration obtained after equilibrating the system at $\tilde{k} = 100$ and $\tilde{\gamma} = 11$. The black dashed line represents an exponential fit to the data in red. The system size is $N = 900$ particles.

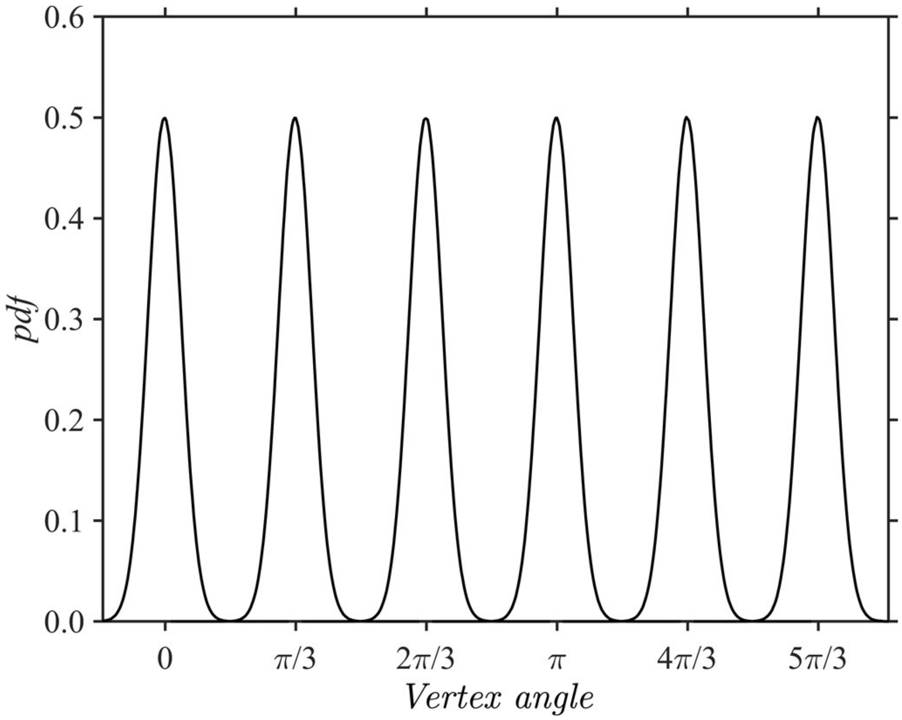

Fig. S3 Probability density function (*pdf*) for vertex angles for the system at $\tilde{k} = 100$ and $\tilde{\gamma} = 60$.

Bond-orientational correlation function. To analyze the characteristic correlation length scales associated with the order–disorder transition in our system, we quantified the bond-orientational correlation function, defined as $g_6(r = |\vec{r}_i - \vec{r}_j|) = \langle \psi_6(\vec{r}_i)\psi_6^*(\vec{r}_j) \rangle$ where ψ_6 is the local bond-orientational order parameter as described by eqn (4) in the main text and ψ_6^* is the complex conjugate of ψ_6. We examined the absolute value $|g_6|$ as a function of $\tilde{r}$ for varying $\tilde{\gamma}$ as shown in Fig. S4. We see that the disordered phase exhibits finite bond-orientational correlation lengths, whereas the ordered phase displays long-range correlations.

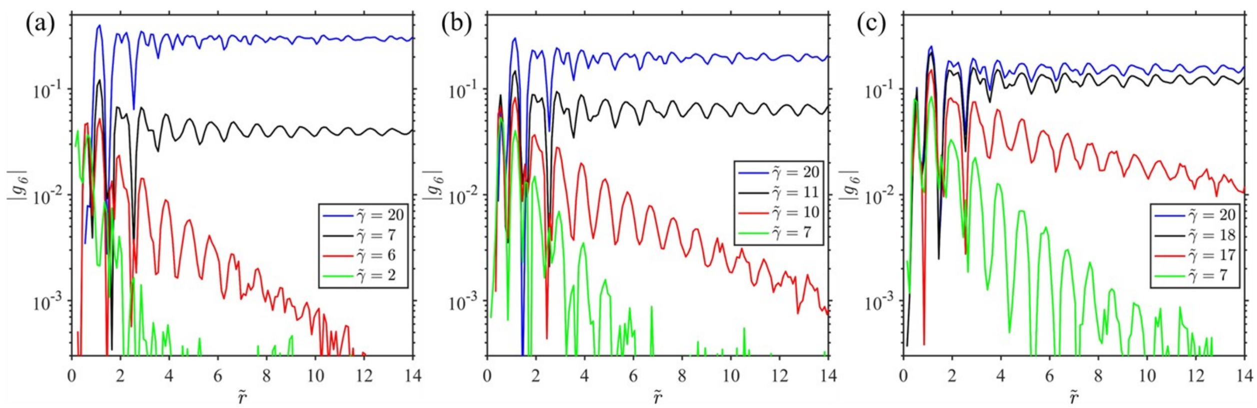

Fig. S4 Absolute value of bond-orientational correlation function $|g_6|$ with distance $\tilde{r}$ for three systems with (a) $\tilde{k} = 1000$ (b) $\tilde{k} = 100$ and (c) $\tilde{k} = 30$ for selected $\tilde{\gamma}$ points in the disordered and ordered states. The simulation box dimensions are 55.836×64.476.

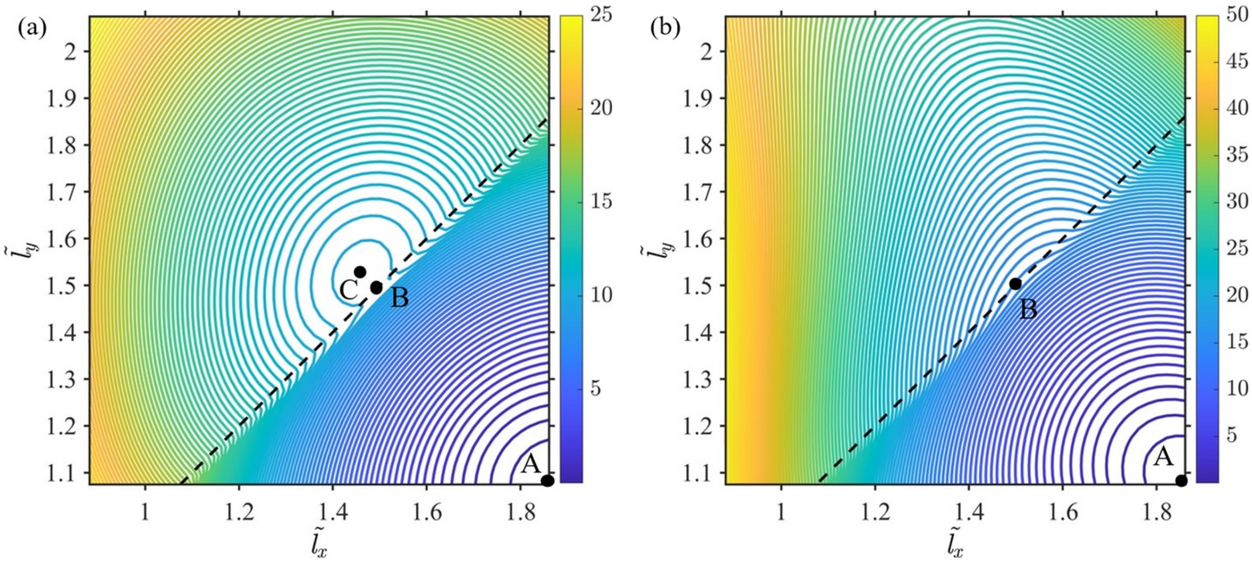

Fig. S5 Contour maps of the system energies relative to the ground state, i.e., the total energy minus the energy of the ground state of the hexagonal crystal lattice, in the $\tilde{l}_x - \tilde{l}_y$ plane at $\tilde{\gamma} = 20$ for (a) $\tilde{k} = 100$ and (b) $\tilde{k} = 1000$. The dashed line is drawn at $\tilde{l}_x = \tilde{l}_y$ which is at the T1 transition. The closed circles labeled A, B, and C indicate a perfect hexagonal state, a state at the T1 transition, and a metastable defect-state, respectively. The corresponding representative configurations are shown in the main text in Fig. 7.

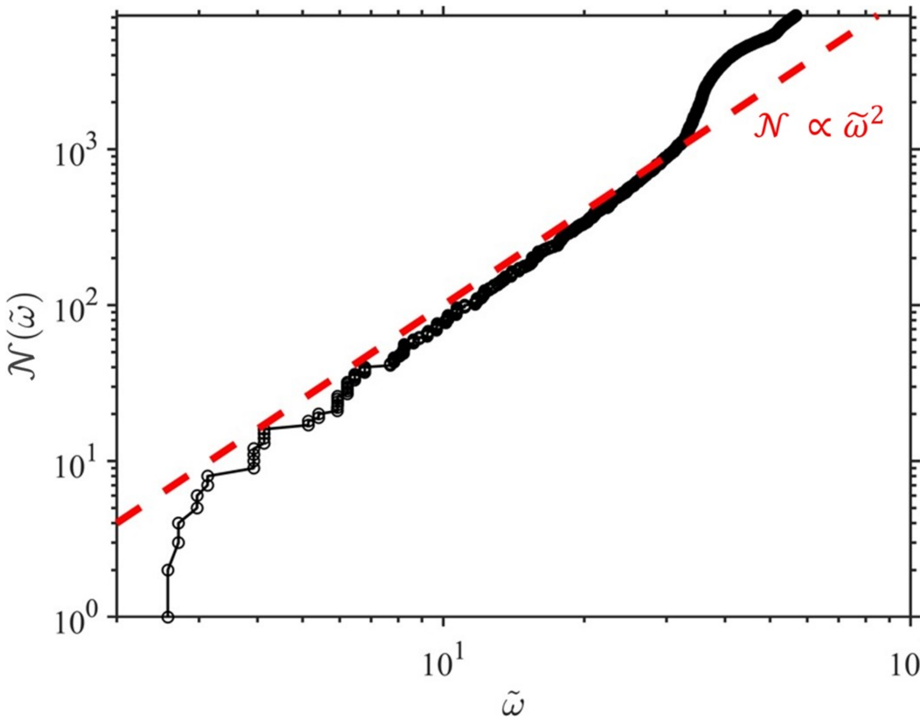

Fig. S6 Cumulative number of normal modes, $N(\tilde{\omega})$, with normal mode frequency, $\tilde{\omega}$ for Voronoi model with $\tilde{k} = 100$, $\tilde{\gamma} = 500$. The red dashed line shows the Debye model prediction that the cumulative number of normal modes scales with the square of the frequency in the low-frequency regime.