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Why square lattices are not seen on curved ionic membranes
CREIGHTON THOMAS, MONICA OLVERA DE LA CRUZ, Department of Materials Science and Engineering, Northwestern University — Ionic crystalline membranes on curved surfaces are ubiquitous in nature, appearing for example on the membranes of halophilic organisms. Even when these membranes buckle into polyhedra with square or rectangular sides, the crystalline structure is seen to have hexagonal symmetry. Here, we theoretically and numerically investigate the effects of curvature on square lattices. Our model system consists of both positive and negative ions with a 1:1 charge ratio adsorbed onto the surface of a sphere. In flat space, the lowest-energy configuration of this system can be a square lattice. This bipartite arrangement is favored because there are two types of ions. It leads to a fundamentally different defect structure than what has been seen when triangular lattices are favored. We classify these defects and find that curvature disrupts long-range square symmetry in a crystal. Through numerical simulations, we see that small square regions are possible in some cases, but this phase coexists with other structures, limiting the scale of these square-lattice microstructures. Thus, at large length scales, curvature leads to triangular structures.

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