

1135-68-2297

Erik Winfree* (winfree@caltech.edu). *Algorithmic Self-Assembly of DNA*.

Self-assembly is a fundamental process in the self-organization of biological as well as non-biological structures. Passive self-assembly of molecular units, being driven just by thermodynamic binding energies and the geometrical structure of the molecules, would seem to be the simplest case to study – but it can be remarkably complicated. In fact, in a model of generalized crystal growth abstracted as the self-assembly of Wang tiles, passive self-assembly can be shown to be Turing universal. This leads to a number of theoretical observations: complex shapes that have concise algorithmic descriptions can be self-assembled from a small number of parts; these self-assembled structures can perform error correction during growth and can self-heal after damage; and as a simple form of self-replication, algorithmic crystals could provide an abiological example of Darwinian evolution. Further, many of these principles can be demonstrated experimentally using molecular Wang tiles constructed from DNA, thus establishing algorithmic self-assembly as part of the molecular programming toolbox for DNA nanotechnology. (Received September 25, 2017)