An Upper Bound for the Bond Percolation Threshold of the Face-Centered Cubic Lattice Via a Growth Process Approach

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We prove that the bond percolation threshold of the face-centered cubic (FCC) lattice is at most 0.19170 by a growth process approach. We construct a graph-valued Markov chain characterizing the growth of the open cluster on a 3D lattice. The Markov chain is then projected onto a 2D plane and compared to a 2D bond percolation process via stochastic ordering, providing an upper bound for the bond percolation threshold of the 3D lattice. We utilize this approach to compare the FCC lattice bond percolation model to the inhomogeneous triangular lattice bond percolation model. Using the inhomogeneous model allows us to tune the parameters to optimize over its critical surface to achieve an better upper bound for the FCC lattice bond percolation threshold.

Keywords: bond percolation threshold, growth process, face-centered cubic lattice, Markov chain, coupling, stochastic ordering