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Abstract: We generalize the Flory-Stockmayer theory of percolation to a model of associating (patchy) colloids, which consists of hard spherical particles, having on their surfaces f short-ranged-attractive sites of m different types. These sites can form bonds between particles and thus promote self-assembly. It is shown that the percolation threshold is given in terms of the eigenvalues of a m x m matrix, which describes the recursive relations for the number of bonded particles on the ith level of a cluster with no loops; percolation occurs when the largest of these eigenvalues equals unity. Expressions for the probability that a particle is not bonded to the giant cluster, for the average cluster size and the average size of a cluster to which a randomly chosen particle belongs, are also derived. Explicit results for these quantities are computed for the case f = 3 and m = 2. We show how these structural properties are related to the thermodynamics of the associating system by regarding bond formation as a (equilibrium) chemical reaction. This solution of the percolation problem, combined with Wertheim's thermodynamic first-order perturbation theory, allows the investigation of the interplay between phase behavior and cluster formation for general models of patchy colloids.

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