Are concepts of percolation and gelation of possible relevance to the behaviour of water at very low temperatures?

Authors: H. E. Stanley [a]; J. Teixeira [b]
Affiliations: [a] Center for Polymer Studies, Boston University, Boston, MA
[b] Laboratoire de Physique Thermique, École de Physique et Chimie, Paris
DOI: 10.1080/00150198008209517
Publication Frequency: 16 issues per year
Published in: **Ferroelectrics**, Volume **30**, Issue **1** October 1980 , pages 213 - 226
Subjects: **Chemical Physics**; **Materials Science**;
Formats available: PDF (English)

Abstract

It is proposed that the unusual low-temperature behavior of liquid water may be interpreted using a simple model based upon connectivity concepts from correlated-site percolation theory. Emphasis is placed on examining the physical implications of the continuous hydrogen-bonded network (or “gel”) formed by water molecules. Each water molecule A is assigned to one of five species based on the number of “intact bonds” (the number of other molecules whose interaction energy with A is stronger than some cutoff V_{HB}). It is demonstrated that in the present model the spatial positions of the various species are not randomly distributed but rather are correlated. In particular it is seen that the infinite hydrogen-bonded network contains tiny “patches” of four-bonded molecules. Predictions based upon the putative presence of these tiny patches for K_T, C_P, and α_P are developed as examples.