

PERCOLATION OF PHASES IN INTERFACE DOMINATED STRUCTURES AND CONSEQUENCES ON PROPERTIES

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Most engineering materials have an interfacial area per unit volume of $S_V = 0.002 \text{ nm}^{-1}$. Exotic processes such as severe plastic deformation can lead to 0.01 nm^{-1} but commercial steels are now emerging with $S_V = 0.1 \text{ nm}^{-1}$, i.e. about 100 million square metres of boundaries within one cubic metre.

It is known at the same time that single phase structures with finely spaced interfaces do not have an adequate capacity for work hardening, the consequence of which is that failure occurs shortly after yielding in a tensile test. This can be resolved by using particular two-phase mixtures. But the totality of properties needed in an engineering application depends also on the way in which these phases are distributed and whether one or both phases have continuity. The technical term for this is 'percolation'; if it is possible to penetrate the material simply by passing through a single phase in the mixture then that phase, for a given morphology, is said to have a volume fraction which is beyond the percolation threshold.

It will be demonstrated that there are dramatic effects on the mechanical properties of percolation on materials that are dominated by the density of phase interfaces, and how the unwanted infusion of hydrogen into such materials depends also on the percolation threshold.