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1987 J. Phys. A: Math. Gen. 20 4573

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COMMENT

Experimental evidence of universality for interacting percolation

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Received 16 February 1987

Abstract. Varying the concentration of cosurfactant in a microemulsion shifts the percolation threshold of the electrical conductivity but does not change the behaviour of the conductivity near the threshold as a function of temperature. The same effect is observed if we add various alcohols.

Normal percolation is random, i.e. every site of a lattice is occupied or empty independent of its neighbours. If occupied sites attract each other as in a lattice gas (Ising model), the percolation threshold is shifted but the critical exponents in general remain the same as for random percolation [1]. This universality principle is violated only if phase separation drastically changes the whole system, i.e. at or below the critical temperature. The present comment gives experimental evidence for these theoretical expectations.

Water-in-oil microemulsions can display electrical conductivity if electrolytic surfactants are involved. This conductivity may be due to charge exchange between different nanometer-sized droplets. It increases by several orders of magnitude at a percolation threshold, where an infinite cluster of these nanodroplets is formed, according to [2-4].

We have measured [2] the electrical current in water-aerosol OT (= AOT, 0.1 mol l^{-1})-isooctane microemulsions with added heptanol. Figure 1 shows the conductivity (in $\Omega^{-1} \text{ m}^{-1}$) as a function of temperature for various heptanol concentrations. Apart from a clear shift of the apparent threshold, the curves remain unchanged. Such a behaviour is consistent with the above universality principle.

Figure 2 shows the same quantity if we replace the heptanol by short-chain alcohols. Again the same pattern is observed in the conductivity plot. Thus in both cases the qualitative critical behaviour remains unchanged. Obviously, our experiments were made at finite temperature in a system with complicated interactions. Random percolation instead would correspond to infinite temperature. Thus we see experimentally that the interactions do not change the universality class.

This work was supported by the Swiss National Science Foundation; it profited from friendly (?) persuasion by D Stauffer.

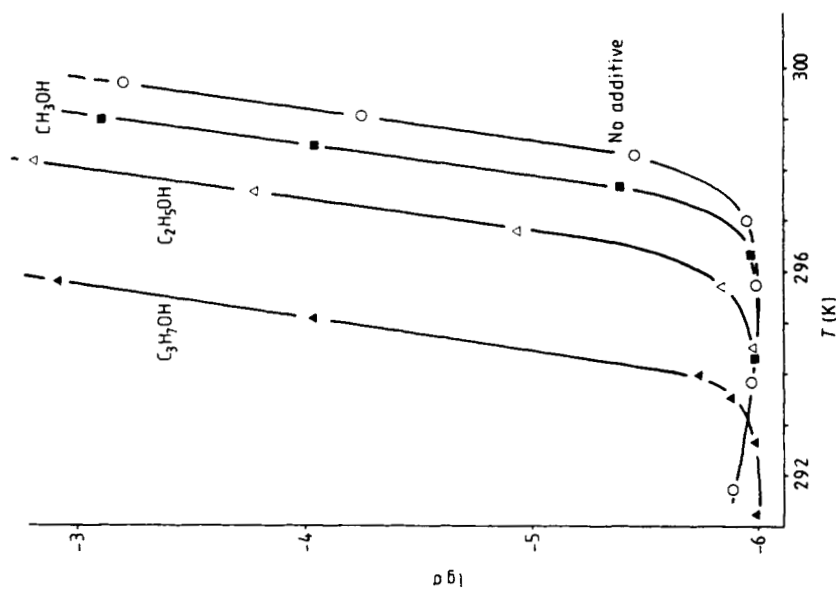


Figure 2. Variation of electrical conductivity (logarithmic scale) against temperature for various alcohols. $[\text{H}_2\text{O}]/[\text{AOT}] = 48.9$ and $[\text{alcohol}]/[\text{AOT}] = 0.34$.

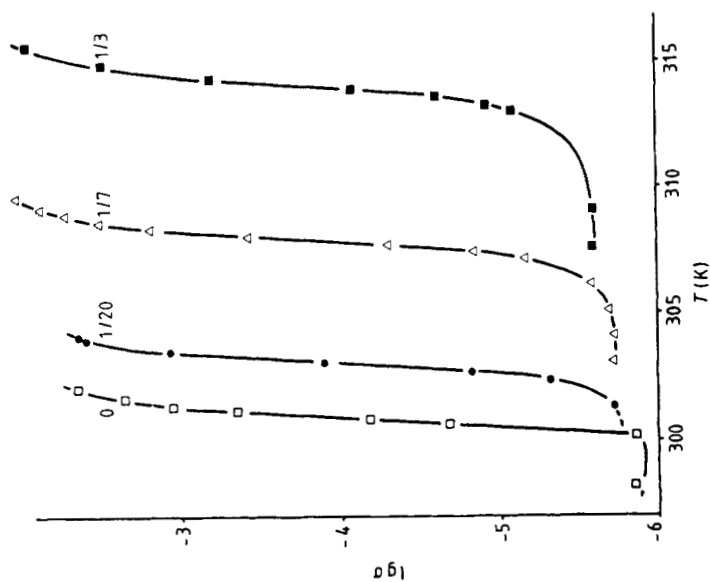


Figure 1. Variation of electrical conductivity (logarithmic scale) against temperature for various heptanol-AOT mol ratios, as shown. $[\text{H}_2\text{O}]/[\text{AOT}] = 61.7$. The system is turbid for ratios 0, 1/20 and 1/7.

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