Fractal growth of liquid crystals as a hysteresis phenomenon

HO-KEI CHAN, INGO DIERKING, School of Physics and Astronomy, University of Manchester, Manchester (U. K.) — Fractal percolation growth of liquid crystal phases within a supercooled isotropic liquid medium has been observed in recent years. Notable examples include the B2 phase of ‘banana’ mesogens [1] and the smectic C phase of a calamitic hydrogen-bonding liquid crystal [2]. Here we present a dynamical model that describes such fractal growth as well as the spherical growth conventionally observed for nematics and cholesterics. The essential idea is that the supercooled medium does not fully respond to the temperature quench immediately (hysteresis). Its fraction of space available for the phase transition only relaxes from 0 to 1 at some finite rate. Depending on the coupling between the relaxation and growth rates, the liquid crystal phase either grows as a percolation cluster of fractal dimension $D \approx 1.89$ or approaches a spherical shape of Euclidean dimension $D \to 2$. The crossover behaviour from relatively slow to fast relaxation is thoroughly investigated. Possible causes of the hysteresis for fractal growth will be discussed.


Ho-Kei Chan
School of Physics and Astronomy
University of Manchester, Manchester (U. K.)