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The Twinkling Fractal Theory of the Glass Transition: Applications to Soft Matter RICHARD WOOL, Chemical Engineering, University of Delaware — The Twinkling Fractal Theory (TFT) of the glass transition has recently been demonstrated experimentally [J.F. Stanzione et al., J. Non Cryst. Sol., (2011, 357,311]. The hard to-soft matter transition is characterized by the presence of solid fractal clusters with liquid-like pools that are dynamically interchanging via their anharmonic intermolecular potentials with Boltzmann energy populations with a characteristic temperature dependent vibrational density of states g(ω) $\sim$ ω^{df} . The twinkling fractal frequencies ω cover a range of 10^{12} Hz to 10^{-10}Hz and the fractal solid clusters of size R have a lifetime τ $\sim$ $R^{Df/df}$, where the fractal dimension $D_f \approx 2.4$ and the fracton dimension $d_f = 4/3$. Here we explore its application to a number of soft matter issues. These include (a) Confinement effects on T_g reduction in thin films of thickness h, where by virtue of large cluster exclusion, ΔT_g $\sim 1/h^{Df/df}$; (b) T_g gradients near bulk surfaces, where the smaller clusters on the surface have a faster relaxation time; (c) Effect of twinkling surfaces on cell growth, where at $T \approx T_g + 20$ C, there exists a twinkling fractal range that leads to bell-shaped enhancement of cell growth and chemical up-regulation via the twinkling surfaces "communicating " with the cells through their vibrations; and (d) adhesion above and below T_g where topological fluctuations associated with g(ω) promotes the development of nano-nails at the interface.

Richard Wool
Chemical Engineering, University of Delaware

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