Soft-matter-physics terms [pln2]

advection Transport within fluid of matter or other conserved quantity via bulk motion.

aggregation Microscopic particles in solution merging and forming mesoscopic or macroscopic structures.

alpha-helix Secondary structure of peptides and proteins with chiral order, stabilized by internal hydrogen bonds.

amorphous Non-crystalline solid phase.

amphiphile Surfactant molecule. Molecule with polar (hydrophilic) end and apolar (hydrophobic or lipophilic) end.

bend Mode of deformation with nonzero $\nabla \times \mathbf{n} \perp \mathbf{n}$ in the director field of a nematic liquid crystal.

beta-sheet Secondary structure of proteins consisting of strands stabilized laterally by hydrogen bonds into a two-dimensional structure.

bilayer Double layer of amphiphiles (e.g. lipids) in aqueous environment stabilized by hydrophobic interactions (e.g. cell membranes).

Bingham plastic Viscoelastic material that requires nonzero threshold shear stress to initiate viscous flow. Example: mayonnaise.

birefringence Anisotropy in optical properties of materials (e.g. refractive index), economically and rapidly controllable in liquid crystals.

bond vector Representation of a monomer as a link of given length and spatial orientation in the conformation of a polymeric chain.

bulk modulus Elastic constant characterizing the volume compression caused by the application of pressure. Inverse of compressibility.

cholesteric Liquid crystal phase with nematic ordering within layers and chirally ordered directors across the layers.

clay Fine-grained soil, silicate-bearing, with low solvent concentration.

coarse-grained Description of a system that takes components below a certain size into account summarily at best.

colloid Particle of submicron size suspended by thermal fluctuations in a fluid dispersion medium.

coexistence curve Boundary between stable and metastable solution macrostates in a mixture of solvent and solute.

coil-globule Conformational change of polymer in solution from extended coil to compact globule with more intramolecular contacts.

coil-helix Conformational change of polypeptide from extended coil

to ordered helix stabilized by internal H-bonds along backbone.

conformation Spatial arrrangements of parts (atoms, monomers, molecular groups) of macromolecules.

contour length Length of fully extended polymer, e.g. polypeptide in coil conformation under tension.

copolymer Polymer with multiple repeat units (monomers). Block copolymers have different repeat units arranged in blocks.

covalent bond Interatomic bond of short range, high directionality and strength, produced by electrons shared by adjacent nuclei.

creep Strain accumulating in solid materials as a result of long-term stress. Also called cold flow.

cross-link Physical or chemical contacts between entangled polymers that prevent viscous flow and produce elasticity.

Deborah number De compares stress relaxation time with characteristic experimental time scale in rheology of viscoelastic mattter.

detergent Surfactant molecules with cleaning properties in dilute solution. Detergents make insoluble particles soluble in some way.

diffusion Transport within fluid of matter or other conserved quantity via random motion of particles.

disclination Topological defect associated with orientational order in solid or liquid crystalline matter.

discotic Columnar liquid crystal phase composed of flat-shaped molecules stacked one-dimensionally.

dislocation Topological defect associated with translational order in solid or liquid crystalline matter.

dispersion Particles dispersed with no order in gas, liquid or solid. Special types: solutions (sub-nm), colloids (sub-μm), and suspensions.

emulsion Homogenized mixture of immiscible liquids. Many emulsion are dispersions: liquid droplets dispersed in a different liquid.

FJC model Polymer represented as a freely jointed chain of rigid links. A tension applied to the ends acts on each link as an aligning force.

foam Gas dispersed in a liquid or a solid. Closed-cell foams have

bubbles. Open-cell foams have a network of channels.

gel Mixture of cross-linked polymers and solvent, capable of elastic deformation, swelling, and shrinking.

glass Material that is solid-like mechanically and liquid-like structurally.

granular Form of matter similar to but different from colloidal. Grains are too massive to be significantly affected by thermal agitation.

homopolymer Polymer with a single repeat unit (monomer).

hydrogen bond Intermolecular bond of moderate strength between electropositive H and electronegative N, O, F,... in polar molecules.

hydrophilic Polar (charge-polarized) molecules or parts thereof, capable of hydrogen bonding (e.g. with water).

hydrophobic Non-polar molecules or parts thereof, repelled by water and other polar molecules.

internal rotation angle Azimuthal angle of bond vector relative to plane of previous two bond vectors in a polymeric chain.

ionic bond Interatomic bond of long range, no directionality, and high strength unless screened by counterions in solution.

Kuhn segment length Characteristic length along contour of polymer such that successive segments are effectively freely jointed.

Lennard-Jones Atomic or molecular interaction potential modelling (electrostatic) repulsive core and (van der Waals) attractive tail

liposome Lipid bilayer shaped into a spherical shell with the same polar fluid inside and outside. Vesicle.

liquid crystal Macrostate of bulk material with liquid flow attributes and attributes of (orientational or translational) long-range order.

lyotropic Phase transition driven by concentration.

melt Liquid form of some substance with particles not dispersed or dissolved in another liquid.

mesoscopic Length scale of the order $\sim$1nm to $\sim 10\mu$m (beween microscopic and macroscopic).

metallic bond Interatomic bond similar to covalent bond but less

directional and with electrons delocalized.

micelle Spherical or cylindrical aggregate of amphiphile molecules stabilized in a polar (or non-polar) fluid by hydrophobic forces.

monodisperse Collection of particles (molecules, colloids, polymers,...) of uniform size or close to it.

nematic Liquid crystal phase with orientational but not translational molecular order.

Peclet number Pe compares advective and diffusive transport rates in rheology of viscoeleastic matter.

permeation Penetration of a permeate (gas or liquid particles) through a solid (e.g. gel, membrane).

persistent length Characteristic length along contour of polymer over which correlation between successive bond vectors persists.

phase separation Transition between homogeneous solution and a heterogeneous state of solute rich and solvent rich components.

polydisperse Collection of particles (molecules, colloids, polymers,...) with a significant spread in sizes.

polycrystalline Solid phase composed of small monocrystalline grains (crystallites).

polymer Macromolecule composed of bonded repeat units (monomers) in uniform, periodic, or aperiodic sequences.

polymorphism Ability of particles to aggregate in different shapes with distinct ordering tendencies.

reptation Diffuse motion of a polymer along the tubular space available to it between other polymers with which it is entangled.

rubber Elastic material composed of a melt of cross-linked polymers.

self-assembly Patterns of spontaneous molecular ordering produced by interplay of enthalpic and entropic forces.

shear modulus Elastic constant characterizing the shear strain response to the application of shear stresss.

shear thickening Nonlinear viscous behavior. Shear modulus increases with shear rate. Examples: pastes, whipped cream.

shear thinning Nonlinear viscous behavior. Shear modulus decreases with increasing shear rate. Examples: paint, yoghurt.

smectic Liquid crystal phase with orientational (nematic ordering and translational order in the form of a density wave.

sol Colloidal dispersion, for example.

spherulite Tertiary structure of crystallized polymers, assembled from chain folded lamellae.

spinodal line Boundary between unstable and metastable solution macrostates in a mixture of solvent and solute.

splay Mode of deformation with $\nabla \cdot \mathbf{n} \neq 0$ in the director field of a nematic liquid crystal.

steric Interactions between particles dominated by hardcore repulsion and particular shapes.

surfactant Amphiphilic molecule. Molecule with polar (hydrophilic) end and apolar (hydrophobic or lipophilic) end.

suspension Dispersion of particles in a fluid that are sufficently large for sedimentation.

thermotropic Phase transition driven by temperature.

twist Mode of deformation with nonzero $\nabla \times \mathbf{n} \parallel \mathbf{n}$ in the director field of a nematic liquid crystal.

valence angle Polar angle between successive bond vectors in the ground state of a polymeric chain.

van der Waals bond Intermolecular bond of intermediate range produced by correlated charge fluctuations in electron wave functions.

viscosity Fluid material constant characterizing the shear stress required to produce a given shear strain rate.

viscoelasticity Soft-matter response to shear stress: elastic (viscous) on short (long) time scales, characterized by relaxation modulus.

Weissenberg number Wi compares rate of shear strain with inverse stress relaxation time in rheology of viscoelastic matter.

Young modulus Elastic constant characterizing the tensile strain response to the application of tensile stress (tension).

This glossary is a work in progress. It is being updated continually. Entries are kept within two lines. Suggestions for new entries, corrections, or improvements are welcome. Drop a line to gmuller@uri.edu.