A PDMS-based broadband acoustic impedance matched material for underwater applications. (arXiv:1805.12192v1 [physics.app-ph])

Having a material that is matched in acoustic impedance with the surrounding medium is a considerable asset for many underwater acoustic applications. In this work, impedance matching is achieved by dispersing small, deeply subwavelength sized particles in a soft matrix, and the appropriate concentration is determined with the help of Coherent Potential Approximation and Waterman & Truell models. We show experimentally the validity of the models using mixtures of Polydimethylsiloxane (PDMS) and TiO2 particles. The optimized composite material has the same longitudinal acoustic impedance as water and therefore the acoustic reflection coefficient is essentially zero over a wide range of frequencies (0.5 to 6 MHz). PDMS-based materials can be cured in a mold to achieve desired sample shape, which makes them very easy to handle and to use. Various applications can be envisioned, such the use of impedance-matched PDMS in the design and fabrication of acoustically transparent cells for samples, perfectly matched layers for ultrasonic experiments, or superabsorbing metamaterials for water-borne acoustic waves.

Transition between globule and stretch states of a self-attracting chain in the repulsive active particle bath. (arXiv:1805.12292v1 [cond-mat.soft])

Folding and unfolding of biopolymers are often manipulated in experiment by tuning pH, temperature, single-molecule force or shear field. Here we carry out Brownian dynamics simulations to explore the behavior of a single self-attracting chain in the suspension of self-propelling particles (SPPs). As the propelling force increases, globule-stretch (G-S) transition of the chain happens due to the enhanced disturbance from SPPs. Two distinct mechanisms of the transition in the limits of low and high rotational diffusion rates of SPPs have been observed: shear effect at low rate and collision-induced melting at high rate. The G-S and S-G (stretch-globule) curves form hysteresis loop at low rate, while they merge at high rate. Besides, we find two competing effects result in the non-monotonic dependence of the G-S transition on the SPP density at low rate. Our results suggest an alternative approach to manipulating the folding and unfolding of (bio)polymers by utilizing active agents.

Study on failure mechanism of Cu-Polyethylene-Cu sandwich structure by molecular dynamics simulation. (arXiv:1805.12348v1 [cond-mat.soft])

The tensile failure mechanism of Cu-Polyethylene-Cu (CPC) sandwich structure was clarified by molecular dynamics (MD) simulations subjected to a uniaxial tensile loading at microscopic scale. The sensitivity analysis of parameters such as model size, relaxation time for equilibrium and initial velocity distribution was carried out to verify the rationality of modeling. The evolutions of stress-strain relationship and each potential energy component were provided to describe the failure process of the structure. The peak of non-bond energy shows a delay compared to the yield point in stress-strain curve, which coincides with the local maximum point of the trans-fraction curve of dihedral angles. After that, an inflexion appeared in the trans-fraction curve indicates an energy transport process, which corresponds with the slope change of the stress-strain curve. It is assumed that the dihedral distribution plays a crucial role in the damage process of CPC structure. In addition, the temperature field and the density profile were adopted to predict the position of damage initiation, which was
confirmed by the microstructure evolution. The intrinsic thickness-dependence of CPC was explored by taking the coupling effect of bridging and entanglement into account, which is in reverse proportion with the yield strength of CPC.

**Mixing and demixing of binary mixtures of polar chiral active particles.** (arXiv:1805.12389v1 [cond-mat.soft])

We study a binary mixture of polar chiral (counterclockwise or clockwise) active particles in a two-dimensional box with periodic boundary conditions. Beside the excluded volume interactions between particles, particles are also subject to the polar velocity alignment. From the extensive Brownian dynamics simulations, it is found that the particle configuration (mixing or demixing) is determined by the competition between the chirality difference and the polar velocity alignment. When the chirality difference competes with the polar velocity alignment, the clockwise particles aggregate in one cluster and the counterclockwise particles aggregate in the other cluster, thus particles are demixed and can be separated. However, when the chirality difference or the polar velocity alignment is dominated, particles are mixed. Our findings could be used for the experimental pursuit of the separation of binary mixtures of chiral active particles.

**Unifying size-topology relations in random packings of dry adhesive polydisperse spheres.** (arXiv:1805.12391v1 [cond-mat.soft])

We study the size-topology relations in random packings of dry adhesive polydisperse microspheres that cover a wide range of global packing fraction through a geometric tessellation. We find that the dependence of the neighbour number on the center particle size is always quasilinear, independent of the size span or interparticle adhesion. The averaged local packing fraction as a function of normalized particle size for different polydispersities is well regressed on the same profile, which grows to larger values as the mean particle size increases. As for the local coordination number-particle size profiles, they converge onto a single curve for all the adhesive particles, but will transfer to another branch for non-adhesive particles. Such size-topology relations are interpreted theoretically by an extended geometrical 'granocentric' model, which was applied previously to describe the jammed packing of granular matter and compressed emulsions. Our findings, together with the modified theory, provide a more unified perspective on the internal geometry of amorphous polydisperse systems, especially those with fairly loose structures.

**Crosslinker mobility weakens transient polymer networks.** (arXiv:1805.12431v1 [cond-mat.soft])

Transient networks comprised of polymers connected by short-lived bonds are a common design theme for both biological and synthetic materials. Transient bonds can provide mechanical rigidity, while still allowing for visco-elastic flows on timescales longer than the bond lifetime. In many biological polymer networks such as the actin cytoskeleton, the short-lived bonds are formed by accessory proteins that diffuse away after unbinding. By contrast, bonds in synthetic networks, such as the pendant groups of telechelic polymers, can only rebind in the same location. Using a recently developed theoretical model of the fracturing of visco-elastic materials, we here investigate the effect of linker mobility on the bond dynamics of a network under stress. We find that although mean field properties such as the average bond linker lifetime are barely affected by bond mobility, networks cross linked by mobile bonds fracture more readily due to 'leaking' of linkers from crack areas to less stressed regions within the
network. We propose a theoretical model to describe the redistribution of mobile linkers, which we validate by simulations. Our work offers insight into a potential trade-off that cells face, between fracture strength versus the modularity and tight dynamic control offered by mobile linkers.

**The normal yield stress.** (arXiv:1805.12461v1 [cond-mat.soft])

Normal stresses in complex fluids lead to new flow phenomena because they can be comparable to or even larger than the shear stress itself. In addition, they are of paramount importance for formulating and testing constitutive equations for predicting non-viscometric flow behavior. Very little attention has so far been paid to the normal stresses of yield stress fluids, mainly because they are very difficult to measure. We report the first systematic study of the first and second normal stress differences, N1 (>0) and N2 (<0), in both continuous and oscillatory shear of three model yield stress fluids. We show that both normal stress differences are quadratic functions of the shear stress both above and below the shear yield stress, leading to the existence of a yield normal stress.

**Waterlike anomalies on the Bose-Hubbard Model.** (arXiv:1805.12470v1 [cond-mat.stat-mech])

Although well-researched as a prototype Hamiltonian for strongly interacting quantum systems, the Bose-Hubbard model has not so far been explored as a fluid system with waterlike anomalies. In this work we show that this model supports, in the limit of a strongly localizing confining potential, density anomalies which can be traced back to ground state (zero-temperature) phase transitions between different Mott insulators. This key finding opens a new pathway for theoretical and experimental studies of liquid water and, in particular, we propose a test of our predictions that can be readily implemented in a ultra-cold atom platform.

**Fiber bundle model under heterogeneous loading.** (arXiv:1805.12474v1 [cond-mat.dis-nn])

The present work deals with the behavior of fiber bundle model under heterogeneous loading condition. The model is explored both in the mean-field limit as well as with local stress concentration. In the mean field limit, the failure abruptness decreases with increasing order k of heterogeneous loading. In this limit, a brittle to quasi-brittle transition is observed at a particular strength of disorder which changes with k. On the other hand, the model is hardly affected by such heterogeneity in the limit where local stress concentration plays a crucial role. The continuous limit of the heterogeneous loading is also studied and discussed in this paper. Some of the important results related to fiber bundle model are reviewed and their responses to our new scheme of heterogeneous loading are studied in details. Our findings are universal with respect to the nature of the threshold distribution adopted to assign strength to an individual fiber.

**Annealing glasses by cyclic shear deformation.** (arXiv:1805.12476v1 [cond-mat.soft])

A major challenge in computer simulations of glassy systems is the ability to generate configurations that may be found in equilibrium at sufficiently low temperatures, in order to probe static and dynamic behaviour close to the glass transition. A variety of approaches recently have explored ways of surmounting this barrier. Here we explore the possibility of employing mechanical agitation, in the form of oscillatory shear deformation, to generate low energy configurations in a model glass former. We show, by performing oscillatory shear deformation simulations over a range of temperatures, shear
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rates and shear deformation amplitudes, that such an approach is capable of speeding up the simulation speeds by several orders of magnitude.

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**Elastic potentials as yield surfaces for homogeneous materials. (arXiv:1805.12493v1 [cond-mat.soft])**

This paper proposes that elastic potentials, which may be rigorously formulated using the negative Gibbs free energy or the complementary strain energy density, should be used as the basis for the plastic part of elasto-plastic constitutive models. Thus, the yield surface may be assumed as an elastic potential surface for a specific level of critical complementary strain energy density. Here, rate-independent homogenous continuous materials under isothermal conditions are considered. Visualization of elastic potentials using principal stresses is presented. The proposed approach improves the total strain energy criterion because: (1) the elastic potential does not have to be centred at the current stress state and, consequently, is able to reproduce a tension-compression asymmetry; (2) the corresponding correlation between the Poisson's ratio and the shape of the yield surface is found for soils and metallic glasses; (3) non-linear elasticity is considered, which notably increases the flexibility and capabilities of the proposed approach. Ultimately, and similarly to hyperelasticity, the proposed framework for deriving (associated) yield surfaces may be considered just as a classifying criterion and a possible approach to formulate yield surfaces. Finally, if an associated flow rule is also assumed, the elastic potential, yield and plastic potential surfaces coincide.

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**Free energy of a folded semiflexible polymer confined to a nanochannel of various geometries. (arXiv:1805.12497v1 [cond-mat.soft])**

Monte Carlo simulations are used to study the conformational properties of a folded semiflexible polymer confined to a long channel. We measure the variation in the conformational free energy with respect to the end-to-end distance of the polymer, and from these functions we extract the free energy of the hairpin fold, as well as the entropic force arising from interactions between the portions of the polymer that overlap along the channel. We consider the scaling of the free energies with respect to varying the persistence length of the polymer, as well as the channel dimensions for confinement in cylindrical, rectangular and triangular channels. We focus on polymer behaviour in both the classic Odijk and back folded Odijk regimes. We find the scaling of the entropic force to be close to that predicted from a scaling argument that treats interactions between deflection segments at the second virial level. In addition, the measured hairpin fold free energy is consistent with that obtained directly from a recent theoretical calculation for cylindrical channels. It is also consistent with values determined from measurements of the global persistence length of a polymer in the backfolded Odijk regime in recent simulation studies.

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**Eshelby description of highly viscous flow -- half model, half theory. (arXiv:1805.12504v1 [cond-mat.dis-nn])**

A recent description of the highly viscous flow ascribes it to irreversible thermally activated Eshelby transitions, which transform a region of the undercooled liquid to a different structure with a different elastic misfit to the viscoelastic surroundings. The description is extended to include reversible Eshelby transitions, with the Kohlrausch exponent $\beta$ as a free parameter. The model answers several open questions in the field.
Diffusion of large particles through small pores: from entropic to enthalpic transport. 
(arXiv:1805.12541v1 [cond-mat.soft])
We present an implicit statistical model for the steric effect on the potential of mean force (PMF) of a molecule diffusing through a flexible nanochannel of varying size. The average cross sectional area profile of the channel and the average minimal projection area of the molecule are the two major quantities determining the steric part of the PMF barrier for the translocation of the particle in the case of a small rigid particle and a large rigid channel. In this case, the description is reduced to the Fick-Jacobs model and the PMF is completely entropic. However, the flexibility of channel's cross section and that of molecule's size play crucial role when a large molecule goes through a narrow channel. The PMF profile changes its statistical nature and becomes enthalpic. We treat the flexibility in terms of the equilibrium fluctuations of the pore and of the molecule, independently. For the case of gaussian fluctuations, we derived simple analytical expressions for the steric barrier.

The mystery of evaporative fluxes surpassing the kinetic limit is revealed: The adsorbed layer evaporates. (arXiv:1805.12560v1 [cond-mat.soft])
Capillary evaporation and the associated passive liquid flow are vital for numerous natural and artificial processes such as transpiration of water in plants [1], solar steam generation [2-3], water desalination [4], microfluidic pumping [5] and cooling of electronic and photonic devices [6]. Recent experiments conducted in nano- and angstrom-scale conduits have shown evaporation rates corresponding to heat fluxes that are one to two orders of magnitude larger than the kinetic theory limit [7,8]. The physical mechanism elucidating these enormous evaporation rates remains vague. Here we report the discovery of lateral momentum transport within and associated net evaporation from adsorbed liquid layers, which are long believed to be at the equilibrium established between equal rates of evaporation and condensation [9]. Contribution of evaporation from the adsorbed layer increases the effective evaporation area, rendering the excessively estimated evaporative heat flux values below the kinetic theory limit. This work takes the first step towards a comprehensive understanding of atomic/molecular scale interfacial transport at extended evaporating menisci. The modeling strategy used in this study opens an opportunity for computational experimentation of steady-state evaporation and condensation at liquid/vapor interfaces located in capillary nano-conduits.