With the growing demands on material systems coming from multiple sectors and with inspiration from biology, interest in colloids and interfaces has evolved from systems that are merely responsive to those that are active. Active colloids are particles and systems that take energy from their surroundings or from on-board reactions to drive their motion or respond to external stimuli actively. Besides swimming of active particles, other material systems can exhibit energy conversions that involve reversible responsive periodic shape changes. The study of mechanisms and the development of new active materials require creation of sophisticated interfaces that sustain reactions and enable the activity. These endeavors comprise an emergent subfield in the area of colloids and interfaces, the focus of this special issue on *Active Colloids and Interfaces in Active Materials*.

The issue opens with a Feature Article by Mihail Popescu,[1] summarizing the state of understanding and science on active particles, addressing their motion, assembly, and collective motion. The feature article then identifies new challenges and opportunities related to shape, interactions, and "motors made out of motors."

Also in this special issue, the next group of papers explores various experimental and theoretical aspects of active colloidal motors undergoing self-diffusiophoresis as a result of enzyme activity,[2] and the influence of nearby solid[3] and liquid interfaces.[4] Yariv further discusses a continuum description.[5]

In consideration of potential applications, the Balazs team uses the concept of chemical pumps to create microscale devices that can autonomously perform multi-step processes.[6] Particle activity can also be used as means of separation as described in simulations of CO_2-induced diffusiophoresis by Shin.[7] A new particle design with large through-holes is proposed by the Liu group[8] and a first attempt at using such porous microparticles for light-propulsion is discussed in Santer's work.[9]

One interesting application of active colloids is environmental remediation, which Wang *et al*.[10] explore in their paper using iron-exchange zeolite micromotors and Tong *et al*.[11] use for organic pollutant degradation. Further advances include the development of micromotors where, in addition to velocity, the direction of locomotion depends on fuel concentration[12] or a feedback loop.[13] The understanding of diffusiophoresis in a variety of solutions is growing: Featured here, the Stone team explore the role of ion valency on particle motion.[14] In addition the influence of active particles on passive particles is explored and found to produce an anisotropic exclusion effect.[15]

Active species swim in bulk but interfaces possess potential to alter gradients and hydrodynamics, explored by Gibbs[16] for particles of complex shapes and by the Stebe group for swimming bacteria.[17] Active droplets can be fueled to drive on surfaces where wetting plays a major controlling role, and trails of surfactant, some laid down by other droplets coordination motion and interaction.[18]

Active particles span from solids to liquids and gases. In the case of bubbles a surfactant layer[19] or a Marangoni flow can be controlled to produce or control direction and speed.[20]

Bubbles can also be used as part of the propulsion mechanism of solid particles, achieving unprecedented velocities on the order of 100 μm/s.[21]
Active particles and assemblies cannot move, but disassemble in response to stimuli, comprising active sensors.[22]

Interaction of particles and templated objects with a magnetic field can direct assembly and motion producing complicated motile structures such as the micro-scallop.[23] At curved interfaces magneto-capillary particle motion can be used for liquid mixing.[24] Other signatures of motion include rolling[25] and surface walking for instance in an asymmetric magnetic field.[26]

Active motion of liquid crystal drops or of species within liquid crystals offers the opportunity to couple activity with additional sophistic function. In active emulsions, for example, droplet size can be controlled,[27] or the liquid crystal itself can be active and exhibit controlled shape transitions.[28] Also in the realm of advanced materials that undergo complex motion are gel capsules that eject materials when stimulated.[29] The concept of active emulsions is explored by Zarzar[30] through metastable droplets that can be triggered by addition of heat.

Dynamics of gels at soft interfaces is investigated by Kuksenok[31] in the context of creating soft active nanostructure interfaces whose topology is controlled by the solvent environment. Design rules for linker-mediated dynamic assembly are expanded in Rogers' contribution[32] by showing that assembly information can be stored in linkers and thereby separated from the colloid used in the assembly, opening up new routes to assembly.

The examples in this special issue comprise just a snapshot of ongoing work in the rapidly evolving field of active colloids and interfaces in active materials. The papers show the breath of behaviors, mechanisms, and applications already being explored and give us an appreciation of further discoveries and impact to be expected from this area.

Ilona Kretzschmar, guest editor
Maria M. Santore, senior editor 2006-2019

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