Soft Matter in Construction

A talk by Emanuela Del Gado

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Sustainability and durability of engineering materials (from green cement to functionalized nano-composites) pose outstanding scientific challenges, in terms of designing novel more sustainable compounds; controlling aging processes at the nano-scale level; and developing new concepts for smart mechanical performances. There is a fundamental contribution that soft condensed matter physics can now give to these questions, and understanding the mesoscale physics emerging in amorphous materials in the critical range of length-scales from nanometers to microns is crucial. I will show how statistical physics approaches combined with particle based nano-scale models and numerical simulations can help us to gain significant insight into structure formation, cooperative processes, and mechanics, for soft glassy materials and complex interfaces [1-4]. Starting from this, I will discuss new approaches for investigating the fundamental mechanisms controlling cement hydration and setting [5-7].

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[3] L. Isa et al., "Adsorption of Core-Shell Nanoparticles at Liquid-Liquid Interfaces", Soft Matter {\bf 7}, 7663 (2011).
[4] K. Schwenke, L. Isa and E. Del Gado, "Crowding and ordering in the assembly of nanoparticles at liquid interfaces", preprint (2013).
[5] E. Masoero, E. Del Gado, R.J Pellenq, S. Yip and F.-J. Ulm, "Nanomechanics of cement setting: Influence of polydispersity on strength", Phys. Rev. Lett. 109, 155503 (2012).
[6] E. Masoero, E. Del Gado, R.J Pellenq, S. Yip and F.-J. Ulm, "Nano-scale mechanics of colloidal C--S--H gels", preprint (2013).
[7] K. Ioannidou, R.J. Pellenq and E. Del Gado, Controlling local packing and growth in calcium-silicate-hydrate gels, preprint (2013).