172c Nano-Colloidal Brushes in Non-Adsorbing Polymer Solutions

Alberto Striolo and Sergei A. Egorov

The appeal of understanding the thermodynamic properties of systems containing large globular particles and polymers stems from economical and technological reasons, but also from the challenge of describing multi-component systems in which large rigid bodies are in solution with long, flexible polymers. Pioneering studies were dedicated to solutions containing large colloidal particles and short polymers (i.e., the colloidal limit)[1]. Subsequently, the scientific interest shifted towards systems containing small colloidal particles and long polymers (i.e., the protein or nanoparticle limit)[2]. These latter systems are relevant for the design of schemes to purify proteins and for the production of self-assembled nanoparticles. We previously investigated the effective interactions between colloids dissolved in non-adsorbing polymer solutions [3,4]. We report here results obtained via canonical (NVT) Monte Carlo simulations and integral equations for the effective interaction potentials between pairs of nano-colloidal brushes dissolved in non-adsorbing polymer solutions. Our calculations span both the colloidal and the protein limits. We discuss how the effective interactions depend on length and density of the side chains on the nano-colloids, as well as on length and density of the non-adsorbing polymers in solution. Our results indicate that while repulsive interactions are always observed between the nano-colloids at short separations, mid-range attractive interactions may arise depending on the ratio between the length of the polymers in solution and the length of the side chains on the nano-colloids. The mid-range attractions appear to be strong enough to promote the formation of gels.

References 1. S. Asakura, F. Oosawa, J. Chem. Phys. 22 (1954) 1255 and J. Polym. Sci. 33 (1958) 183. 2. R. Tuinier, J. Rieger, C.G. de Kruif, Adv. Colloid Interface Sci. 1-3 (2003) 1. 3. A. Striolo, C.M. Colina, K.E. Gubbins, N. Elvassore, L. Lue, Mol. Sim. 30 (2004) 437. 4. N. Patel, S.A. Egorov, J. Chem. Phys. 121 (2004) 4987.