AN ANALYTIC EXPRESSION FOR THE DISJOINING PRESSURE BETWEEN PARTICLE-STABILIZED FLUID–FLUID INTERFACES AND COMPOSITE MATERIALS

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A general method based on a hybrid Hamaker-Lifshitz approach is described in order to calculate the disjoining pressure (i.e. van der Walls forces per unit area) of thin films between two drops having Janus nanoparticles at their interfaces. The drops are modeled here as half spaces and the spherical particles are arranged in 2D-lattices straddling the interfaces. Analytical expressions are derived to consider the effects of particle concentration, size, core material and relative position of the facing lattices on the disjoining pressure. Knowledge of the dependence of the disjoining pressure on these quantities is necessary to determine the ability of the nanoparticles to stabilize immiscible polymer blends against coalescence, thus in the design of effective nanoparticles stabilizers. The method is also applied to the case of two compound half spaces of polymers with 3D lattices of spheres dispersed in it interacting across a medium. This system is considered as a model for drops with particles dispersed in their bulk or for interacting colloidal/nanocrystals and as a test case to validate our method against well known effective medium expressions. Our method is promising for its ability to deal with complex geometries and with the presence of an intervening medium in a simple way, thus leading to analytical expressions that can be used both in experiments and in numerical simulation studies. Its main limitation is that multibody interactions are only included by evaluating the Hamaker constants through the Lifshitz approach.