

A Global Investigation About Hard Core Attractive Yukawa Approximation and Adhesive Hard Sphere Approximation for Structure of Colloidal Dispersion Systems

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Abstract: The accuracy of hard core attractive Yukawa (HCAY) potential and adhesive hard sphere (AH) potential in representing the structure factor of short range square well potential and Asakura and Oosawa (AO) depletion potential is examined by comparing theoretical predictions with the existing simulation data and the present numerical results from the non-linear optimized random phase approximation closure for Ornstein-Zernike equation. For the case of square-well (SW) potential, it is shown that the structure factor of HCAY potential based on a recently proposed semi-analytical expression for the radial distribution function can describe the structure factor of SW potential with reduced well width $\lambda \leq 2$ only if the reduced contact potential $\beta \epsilon_{sw} \leq 0.25$, while the analytical expression for the structure factor of AH potential under Percus-Yevick (PY) approximation completely fails for the case of $\lambda > 1.2$. For the case of AO depletion potential, the domain of validity of both HCAY potential and AH potential is complementary. With the above analysis and considering the solid-liquid transition of the AH potential with an adhesive parameter τ below 1.31 cannot be predicted by modified weighted density approximation, the role played by the HCAY potential about the mapping manipulation should not be ignored.

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