Thermodynamics and structural properties of anisotropic colloids with square-well attractions.

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We study the phase behaviour of hard ellipsoids (prolates and oblates) with superimposed short-ranged square-well attractions using the replica exchange Monte Carlo method. Other ranges are set (λ =0.25, 0.5, 0.75 y $1.0\sigma_{min}$, with $\sigma_{min} = \min(\sigma_{\parallel}, \sigma_{\perp})$), andthe effect of varyingthe aspect ratiowas studied, $\kappa = {}^{\sigma_{\perp}}/_{\sigma_{\parallel}}$, of hard core ellipsoidal for prolate and oblate. The obtained results were density profiles, and for the vapor-liquid and isotropic-nematic-cubatic(for oblates) and isotropic-nematic-aggregates (for oblates).By fixing the square-well range ($\lambda = 0.25\sigma_{\parallel}$), we examine the effect to varying the oblates aspect ratio, on the density profiles, vapor-liquid. We observe that the formation of a vapor-liquid phase coexistence with vanishing critical volume fraction (empty liquid) is predicted in some model systems of attractive hard ellipsoids. The trends in critical density and temperature do not depend on the shape of the ellipsoid and the range of the square-well attraction. Our simulation studies show transparently that the empty liquid limit is due to the competition between the anisotropic attractive and repulsive attractions. Additionally, the nematic phase is destabilized by the square-well attraction for both prolate and oblate shapes. The demand to maximize the number of bonds while keeping a relatively low excluded volume leads to special structures such as the cubatic and star-shaped cluster phases at low temperatures. The liquid branch of the vapor–liquid binodal is always isotropic for oblates, while it can be isotropic or cluster-like for prolates. Our results predict the occurrence of an empty liquid state in high valence anisotropic colloidal systems.