Anti-clumping strategy for nanoparticles

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Nanoparticles are ubiquitous in industrial applications ranging from drug delivery and biomedical diagnostics to developing hydrophobic surfaces, lubricant additives and enhanced oil recovery solutions in petroleum fields. For such nanoparticles to be effective, they need to remain well dispersed into the fluid surrounding them. In a study published in *EPJ B*, Brazilian physicists identified the conditions that lead to instability of nanoparticles and producing aggregates. This happens when the electric force on their surface no longer balances by the sum of the attractive or repulsive forces between nanoparticles. These findings were recently published by Lucas de Lara from the Centre for Natural and Human Sciences, at the University Federal of ABC (UFABC) in Santo André, SP, Brazil and colleagues.

The authors studied silica nanoparticles that do not react with their surroundings in a solution containing two types of salts, table salt and calcium chloride. They then attached an ending to the nanoparticles, a process called functionalisation. Featuring endings that are hydrophilic or hydrophobic can help nanoparticles remain dispersed.

They then varied the temperature and salt concentration and monitored the ion dispersion in the salty solution. In some cases, they observed the accumulation of ions around nanoparticles, leading to the formation of an electric double-layer around the nanoparticles in otherwise overall electrically neutral nanoparticle suspensions.

De Lara and colleagues then determined the factor influencing the stability of such nanoparticles in solutions. Their simulations suggest that the instability of functionalised nanoparticles dispersion in brine depends on several factors preceding their aggregation. The "culprits" include the formation of an electric double layer - observed to be greater for calcium chloride than for table salt - and the narrowing of that double layer. In addition, the considerable variation in the interface tension followed by a steep increase in ion mobility also contribute to instability. The group's findings on overall neutral nanoparticles are in line with previous work with electrically charged nanoparticles.

More information: Lucas S. de Lara et al. The stability and interfacial properties of functionalized silica nanoparticles dispersed in brine studied by molecular dynamics, *The European Physical Journal B* (2015). DOI: 10.1140/epjb/e2015-60543-1

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