Influence of Hydrophobic Character and Anionic Size on the Adsorption of Halogenated Borate Salts on Model Colloids

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This study presents a comparative analysis of the adsorption behavior of a series of halogenated borate salts (Na 2 B 12 X 12 , where X = H, F, Cl, Br, I) on two distinct colloidal systems: hydrophobic polystyrene latex particles and hydrophilic chitosan particles. Both systems possess a positive surface charge, with the divalent borate anions acting as counter-ions and sodium as co-ions. E lectrophoretic mobility measurements demonstrate a remarkable sensitivity of the hydrophobic system to the nature of the specific anion used showing significant charge reversal with all tested salts. By contrary, for the hydrophilic system, only with the biggest anions a small charge reversal was observed. Hence, anion adsorption is significantly higher on hydrophobic particles compared to hydrophilic ones across all tested salts. A critical finding is the direct correlation between the size of the halogen atoms surrounding the boron cluster and the adsorption capacity: as the ionic radius increases, the drop in electrophoretic mobility becomes more pronounced, leading to charge reversal at lower concentrations. For instance, while differences for the Na 2 B 12 H 12 anion become relevant above 5 10 -4 M, the Na 2 B 12 Br 12 anion shows significant effects starting from concentrations as low as 10 -7 M. Finally, a comparison with "classical" inorganic salts such Na 2 SO 4 (also with a -2 charge) is done. The results obtained with the sulfate ion highlight the differences in interaction between hydrophobic and hydrophilic systems, aligning with observations made regarding borate ions. This underscores that in order to explain the specific interaction of these nanoions with any interface, one must consider not only their size and charge density [1] but also the nature of the colloidal surface with which they interact as in the classical Hofmeister effects.[2]

References:

[1] Philipp Dullinger and Dominik Horinek. Solvation of Nanoions in Aqueous solutions *J. Am. Chem. Soc. 2023,* 145, 24922-24930.

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