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Tuning the Nano Structures of Micellar Aggregates through a New Group of Surfactants, as Studied by SANS and SAX

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Cationics are widely used for various applications, e.g. fabric softening, antimicrobial action, oilfield applications and pesticides, all of which involve the strong interaction of the cationic group with an oppositely charged surface. Their role would be considerably widened if the nonionic ethoxylate grouping could be reliably and accurately attached to the cationic group as it can for anionic surfactants. The incorporation of nonionic hydrophilic groups with anionic groups is particularly effective in that the nonionic groups improve solubilization, lower the Krafft point, and mitigate the effects of higher valence ions on aggregation or precipitation. Part of this pattern of behaviour seems to be that such surfactants show a tendency to form complex layers at the air water interface, e.g. multilayers, as formed by the alkyl ethoxy sulfonates.

We have successfully synthesized a novel category of cationic surfactants, which incorporated a substantial fraction of nonionic ethylene oxide groups in a configuration where two ethylene oxide groups of nearly equal length and a single group are attached to the quaternary nitrogen The new method of making the ethoxylated cationics makes it possible to combine relatively precise amounts of EO as a pair of chains of close to equal length with a final single EO to create the cationic charge and hence to tune the amphiphilicity reasonably accurately. The self-assembly of this series cationic surfactants and its precursors, non-ionic surfactants has been investigated by small angle neutron and small angle X-ray, respectively. What we found is the micelle size of the cationic charged micelles has smaller size than the corresponding non-ionic micelles, and the size of their mixture is lower than non-ionic surfactant but is higher than cationic one. This may provide a simple and controllable methodology to tune the Nano structure of surfactant aggregates using a mixture of cationic and non-ionic surfactant 'homologue'.

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