Electronic Supplementary Material (ESI) for RSC Advances.

Evidence for extractant mediated nano-aggregate formation in Triton X-114 aided cloud formation

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Electronic Supplementary Information

Experimental:

TEM studies:

TEM micrographs were recorded on a Libra plus 120 keV Electron Microscope (Carl Zeiss) using 200 mesh formvar-coated copper grids after staining with uranyl acetate. Samples for TEM were prepared by staining technique with a uranyl acetate water solution.[1] The sample was loaded on a copper grid pre-coated with carbon by immersing into the solution at least for 5 minutes. The copper grid was transferred into the uranyl acetate solution after removing the excess of solution using filter paper. After approximately 2 minutes, the grid was removed from the uranyl acetate solution and excess liquid was again removed prior to TEM measurements. High speed refrigerated centrifuge from SIGMA Laborzentrifugen GmbH, Germany was used for separating the surfactant rich phase after cloud formation from the aqueous medium.

Cloud formation studies:

The cloud formation studies were performed using a refrigerated reciprocal shaking water bath (Thermo Fisher Scientific India Pvt. Ltd). Viscosity measurements were done by Stabinger Viscometer (Model No. SVM 3000) procured from Anton Paar, Austria. The clouding behavior of Triton X114 under desired experimental conditions was studied in glass stoppered tubes of 15 mL capacity. The aqueous samples containing Triton X114 were equilibrated in a temperature controlled water bath for observing the phase changes (clouding behavior).

SANS studies:

SANS experiments were carried out at the Dhruva Reactor, Bhabha Atomic Research Center, Trombay, India. The SANS diffractometer makes use of a beryllium oxide filtered neutron beam of mean wavelength (λ) 5.2 A ° , and the data were collected within the Q (scattering vector $Q = 4\pi \sin \theta/\lambda$, where 2θ is the scattering angle) range of 0.02-0.20A ° -1. The samples were taken in quartz sample holder of 0.5 cm path length having tight fitting Teflon stopper.

Fig. S1 Variation of viscosity of 0.12 % (w/v) Triton X 114) with temperature as a function of DBM concentration in 0.1 M Na-acetate

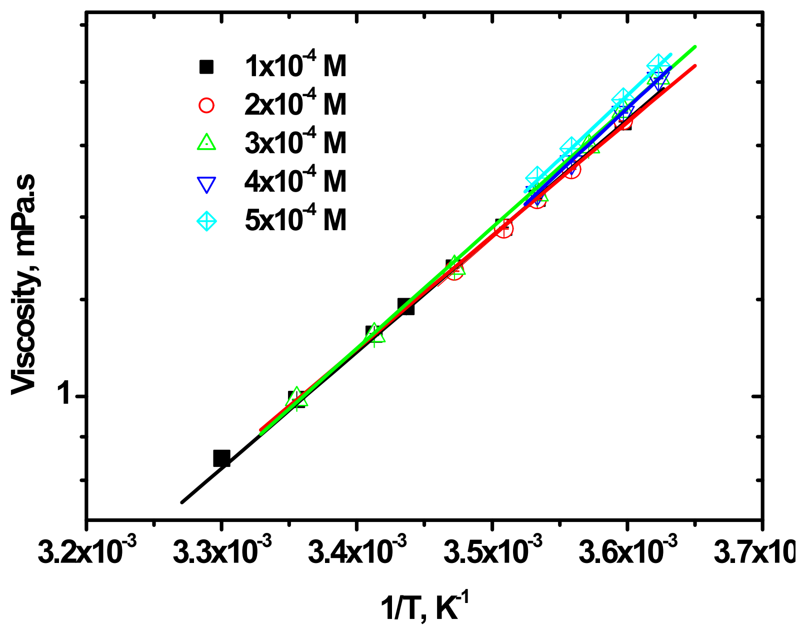


Fig. S2 Variation of viscosity of 0.12 % (w/v) Triton X 114) with temperature as a function of HTTA concentration in 0.1 M Na-acetate

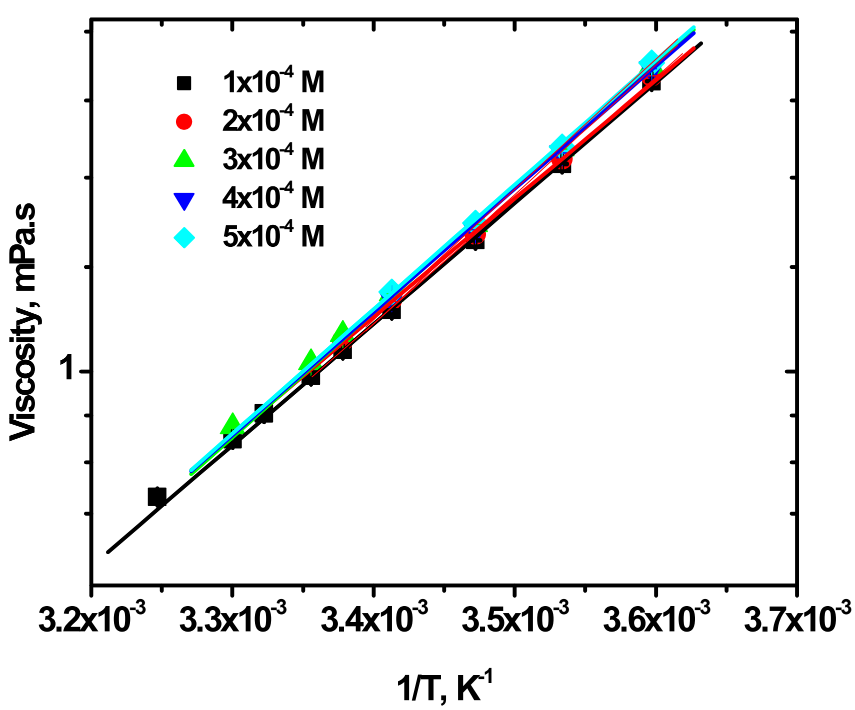


Fig. S3 Variation of viscosity of 0.12 % (w/v) Triton X 114) with temperature as a function of PMBP concentration in 0.1 M Na-acetate

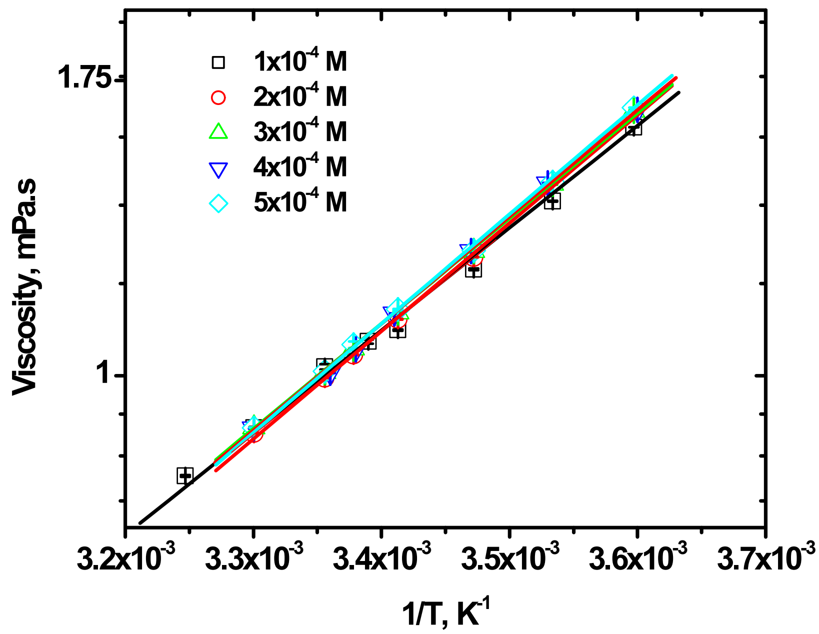


Fig. S4 Variation of viscosity of 0.12 % (w/v) Triton X 114) with temperature as a function of TBP concentration in 0.1 M Na-acetate

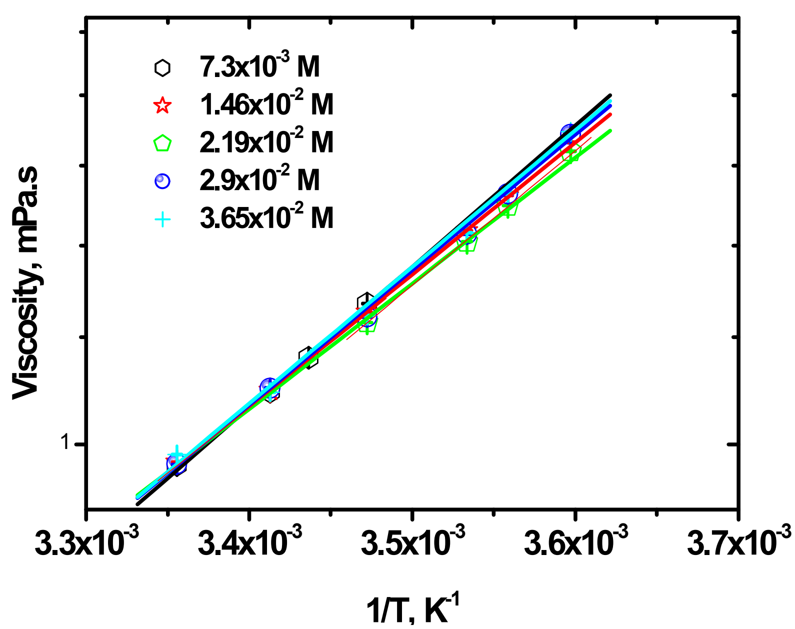


Fig. S5 Changes in surface tension as a function of Tritin X-114 concentration in the absence and presence of varying concentrations of TBP

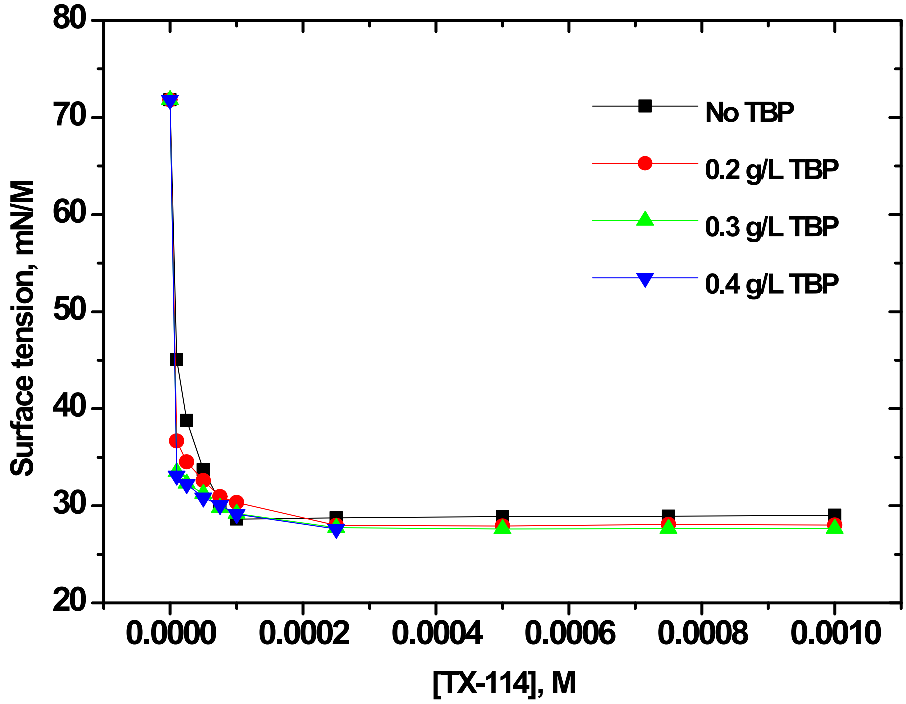
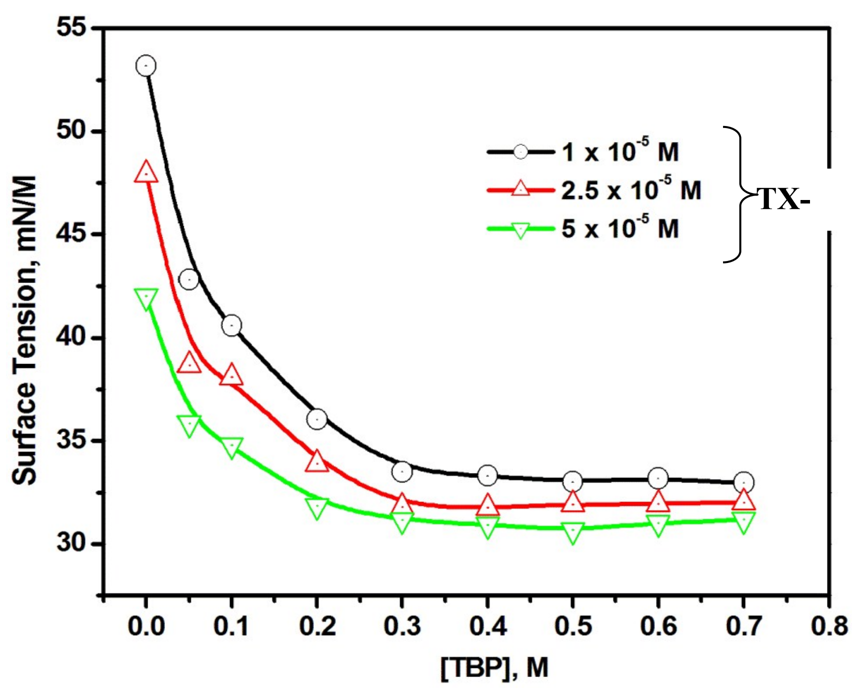


Fig. S6 Variation of surface tension with varying TBP concentration at different Triton X -114 concentration



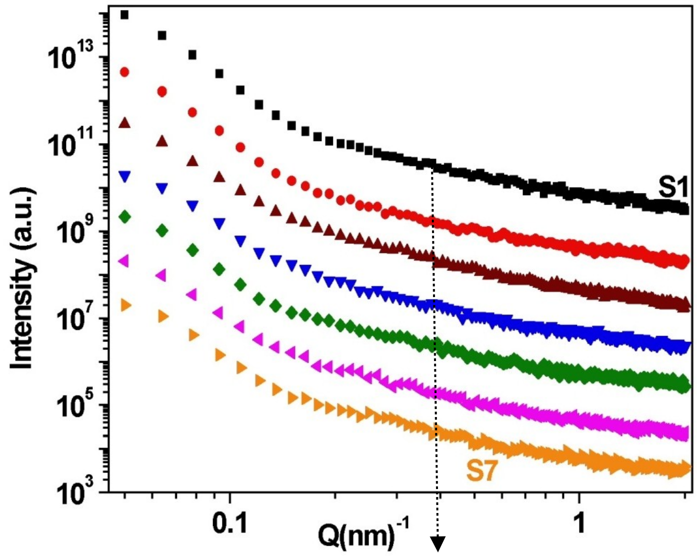
3.2 SAXS studies

These measurements were also performed on seven different samples (**Table S1**) to know about the size of the micelles (smaller units) and the vesicles (larger units). This technique is very useful for understanding the size distribution of particles under different conditions. The intensities I(Q) were measured using small angle goniometer in which I(Q) had been recorded in steps of scattering angle 2θ in transmission geometry, where, Q is the scattering vector equals to 4π.sin(θ)/λ, and λ is the wavelength of the incident X-rays. The measured intensities were corrected for absorption and slit smearing effects.[2] **Figure S6** shows the SAXS profile of all the solutions plotted on log-log scale. The low-Q region of the scattering profiles arises from larger size scatterers whereas the high-Q region belongs to the objects of smaller length scale. The data from each solution indicate structures with two different morphologies. It is known that the surfactant solutions consisting of micelles from as aggregates or clusters. In the low Q-region, the linear behavior of the profiles indicates a power-law of the intensity $I(Q) \sim Q^{-\alpha}$. This region represents the scattering from the surface of the larger aggregates. The value of α is > 4 for all the solutions indicating a fuzzy or diffuse boundary of the aggregates.[3]

Table S1 Details of different samples used for SAXS measurements

Sample No.	**Composition**
S1	0.12% (w/v) Triton X114 in Millipore water
S2	1.2% (w/v) Triton X114 in Millipore water
S3	0.12% (w/v) Triton X114 in 0.1M Na-acetate
S4	$1x10^{-4}$ M DBM + 0.12% (w/v) Triton X114 in 0.1M Na-acetate
S5	$1x10^{-4}$ M HTTA + 0.12% (w/v) Triton X114 in 0.1M Na-acetate
S6	$7.3x10^{-3}$ M TBP + 0.12% (w/v) Triton X114 in 0.1M Na-acetate
S7	$1x10^{-4}$ M PMBP + 0.12% (w/v) Triton X114 in 0.1M Na-acetate

Fig. S6 Small angle X-ray scattering data of sample solutions S1-S7 in serial order



References

1. S.N. Kalmykov, M.N. Denecke, Actinide Nanoparticle Research. Springer-Verlag, Berlin Heidelberg, Chapter 1, pp.33, 2011.
2. P.W. Schmidt, R. Hight Jr. Slit height corrections in small angle X-ray scattering, Acta. Crystallogr. 13 (1960) 480–483.
3. P.W. Schmidt, D. Anvir, D. Levy, A. Hohr, M. Steiner, A. Röll. Small Angle X-Ray scattering From the Surfaces of Reversed Phase Silicas: Power-Law Scattering Exponents of Magnitudes Greater than Four. J. Chem. Phys. 94 (1991) 1474-1479.