Depletion induced spherical-cylindrical transition in C12E5 microemulsion

Masoud Amirkhani[1],Soheil Sharifi[2], Sérgio S. Funari[3],Othmar Marti[1]
1 Institut für Experimentelle Physik, Universität Ulm, Albert-Einstein-Allee 11 89081 Ulm, Germany
2 Department of Physics, University of Sistan and Baluchestan, 98135-674 Zahedan, Iran
3 HASYLAB, Notkestrasse 85, D-22607 Hamburg, Germany

Three different molecular weight of Polyethylene glycol (PEG) was used to study the effect of depletion on the morphology of $C_{12}E_5$-microemulsion. Figure 1, show the scattering intensity as function of the scattering vector of $C_{12}E_5$-microemulsion/PEG at constant droplet mass fraction (m_{fdrop}=0.1) and m_{Dec}/m_{C12E5}=1.08 with different concentration ($0.01<m_{fpoly}<0.06$) of PEG (M_n=2200).

For M_n=285-315, by varying PEG concentration from 0.01 to 0.1 apparent shape of scattering intensity does not change. However, for M_n=2200 and M_n=6000 by increasing the concentration of polymer the shape of scattering intensity clearly changes in low q (fig.1). For analyzing the SAXS data a model for two ranges of the q is written. In the low q, a monodisperse hard spheres model with an attractive depletion potential and in the higher q a polydisperse hard sphere is used[1 &2].

Our results show that for lowest length scale of PEG (M_n= 283-315) the size ratio (ξ-the ratio of droplets size to polymer size) is changing from 0.41 to 0.09 by increasing PEG content but the size (65Å) and polydispersity (0.2) of droplets are constant. As the size of the microemulsion is constant so the aggregation of polymers could be the reason for changing the size ratio.

For the higher length scale of PEG (M_n =2200 and 6000) by increasing PEG concentration the depletion interaction causes the aggregation of droplets and a spherical-cylindrical transition is observed, fig.1. The transition is appeared at $m_{fpoly} > 0.03$ and $m_{fpoly} > 0.01$ for M_n=2200 and M_n=6000, respectively (fig.1). In figure 1 it is illustrated that the hard sphere model was failed for high concentration of polymer. However, the data is well fitted with a power law, $I(q) \approx q^{-1}$, at $0.04Å^{-1}<q<0.07Å^{-1}$ for the C12E5-microemulsion/PEG system at high PEG concentration and M_n=2200 and M_n=6000, which is hallmark of the cylindrical property of droplets[3].

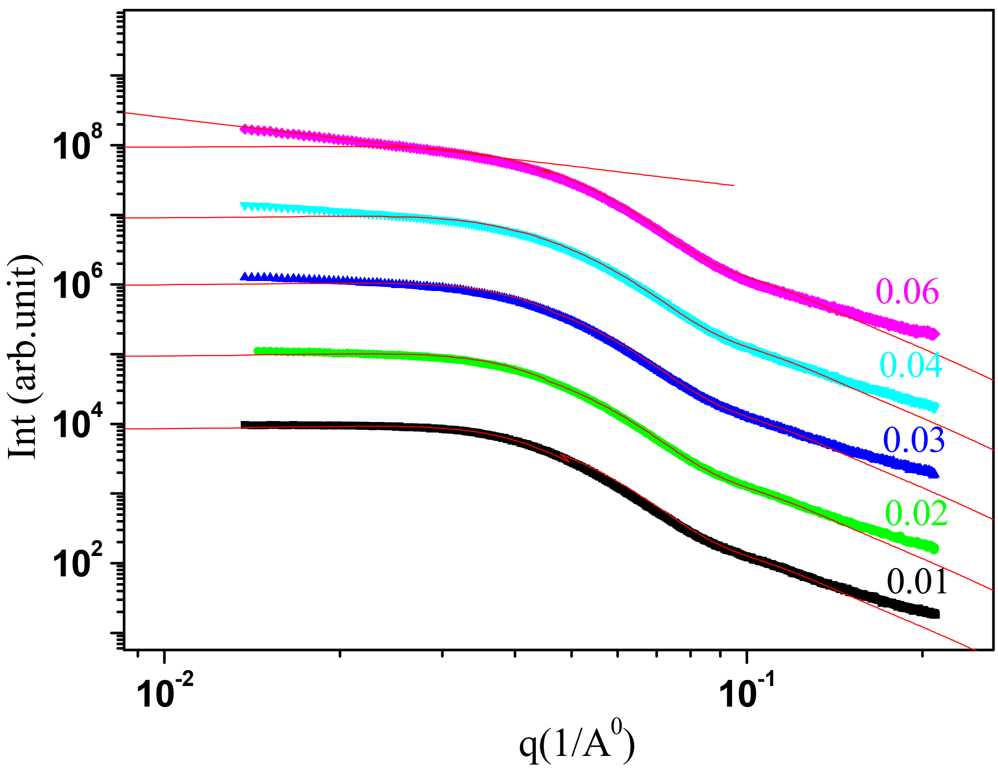

Fig.1. The SAXS experiment for $C_{12}E_5/H_2O$/n-Decane/PEG microemulsion at constant droplet mass fraction (0.1) and m_{Dec}/m_{C12E5}=1.08 and different concentration of PEG at molecular number 2200 (from down to up, $m_{f,poly}$=0.01□,0.02□, 0.03▲,0.04▼,0.06♦) at 27.2 ^oC. The points are SAXS data and curve lines are the fit. The straight line is fit with a power law, $I(q) \approx q^{-1}$, with properties of a cylindrical object.

References

[1] Gerhard Fritz and Otto Glatter, *J. Phys.: Condens. Matter* **18**, S2403–S2419 (2006)

[2] S. Finet, A. Tardieu, *Journal of Crystal Growth* **232,** 40–49 (,2001)

[3] U. Menge, P. Lang, and G. H. Findenegg, *J. Phys. Chem. B* **107**, 1316-1320 (2003)