Application of Surface Enhanced Raman Scattering to cationic surfactants exhibiting low critical micelle concentration

G. N. Mathioudakis[1#], A. Soto Beobide[1], G. Bokias[1,2], P.G. Koutsoukos[1,3] and G. A. Voyiatzis[1*]

[1] Foundation for Research & Technology-Hellas (FORTH), Institute of Chemical Engineering Sciences (ICE-HT), Rio-Patras, Greece

[2] Department of Chemistry, University of Patras, Rio-Patras, Greece

[3] Department of Chemical Engineering, University of Patras, Rio-Patras, Greece

Presenting author: G. N. Mathioudakis, email: mathioy@iceht.forth.gr
* Corresponding author: G. A. Voyiatzis, email: gvog@iceht.forth.gr

ABSTRACT

Surface Enhanced Raman spectroscopy (SERS) is considered as a valuable high sensitive detection method, which enhances many orders of magnitude the Raman intensity of molecules in the immediate vicinity to nano-rough noble metal surfaces or nanocolloidal noble metals clusters. The strong signal enhancements are derived from localized “hot spots”, especially in the metallic nanocolloidal suspensions obtained by chemical reduction. [1]

In the present study, SERS technique has been applied *via* silver nanocolloids to monitor the critical micelle concentration (CMC) of three cationic surfactants bearing quaternary ammonium group: hexadecyltrimethyl-ammonium bromide (CTAB), dodecyltrimethylammonium bromide (DTAB) and benzalkonium chloride (BAC). Surfactant solutions have been prepared in 0.5M NaCl, simulating sea water, according to the requirements of a relevant application. [2] DTAB and CTAB exhibit very similar structures, with the same hydrophilic/polar trimethylammonium bromide "head", the former having 12 carbon atoms alkyl chain and the latter 16. BAC has a phenyl group attached to the quaternary ammonium group, while the alkyl chain has variable even-numbered carbon atoms chain length. The differentiation in terms of shape and size of related micelles for the three different cases is reflected in the relevant SERS signal. The CMC values determined by this method were consistent with the corresponding verified by conventional methods, such as fluorescence probing and electrical conductivity.

In parallel, the potential application of SERS technique especially for low CMC determination, without involving surface modification of silver nanoparticles by a Raman-active molecule was also explored. [3]

REFERENCES

[1] Anastasopoulos A, Soto Beobide A, Voyiatzis GA. 2013, *J. Raman Spectrosc.*, **44**, 401-405.
[2] Mathioudakis G N, Soto Beobide A, Koromilas N D, Kallitsis J K, Bokias G and Voyiatzis G A. 2016, *eXPRESS Polym Lett*, **10**, 750- 761.
[3] Mathioudakis G N, Soto Beobide A., Bokias G, Koutsoukos P G and Voyiatzis G A . 2019, *J. Raman Spectrosc.*(under review)