The Low-Fouling Effectively Charged Polybetaine Brushes

Alina Pilipenco[a], Michala Forinová[a], Zulfiya Černochová[b], Zdeňka Kolská[c], Hana Vaisocherová-Lísalová[a], Milan Houska[a]*

[a] FZU - Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 180 00 Prague, Czech Republic

[b] Institute of Macromolecular Chemistry CAS, Institute of Macromolecular Chemistry CAS, Heyrovského nám. 2, Prague, 16206 Czech Republic

[c] Faculty of Science, J. E. Purkyně University in Ústí nad Labem, České Mládeže 8, Ústí nad Labem, 400 96 Czech Republic

Polybetaine nanobrushes are widely used as inert platforms for label-free biosensing due to their resistance to non-specific interactions. Despite being considered cationic or electrically neutral, these nanobrushes can exhibit negative zeta potential (ZP) at pHs above their isoelectric point (pI). To investigate whether negative ZP contributes to surface interactions, we studied three types of nanobrush deposited on a gold substrate: poly(carboxybetaine methacrylamide) (pCBMAA), poly(sulfobetaine methacrylamide) (pSBMAA), and poly[N-(2-hydroxypropyl)methacrylamide] (pHPMAA), which has no ionic groups. All three nanobrushes have well-defined pI and a negative surface ZP [1] above their pIs. The pH-dependent interactions of these nanobrushes with anionic dextran sulfate (DS) and cationic poly[(N-trimethylammonium)ethyl methacrylate] (PTMAEMA) were monitored by infrared reflection spectroscopy (IRRAS and GAATR).. DS adsorbs strongly to pCBMAA and only weakly to pSBMAA at pH values below their isoelectric points (pI), but can also adsorb slightly to both polybetaine polymers even at pH values above their pIs. This is because the sulfate groups on DS displace the carboxylate or sulfonate groups from interacting with the quaternary ammonium cations. However, DS does not adsorb to pHPMAA at any pH, and PTMAEMA does not interact with any of the polymers, regardless of the pH. These results [2] suggest that zeta potential measurements alone may not be enough to predict electrostatic interactions, as an apparent negative charge does not always translate into a functional surface charge that influences macromolecular interactions.

Keywords: surface zeta potential, polymer brushes.

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References

(Calibri, 10 pt.)Please ensure that every reference cited in the text is also present in the reference list. Follow the format below for this purpose:

[1] Tomsik E., Cernochova Z., Scheibe M. and Tadyszak K. Lithium phthalocyanine (γ-structure) as a molecular oxygen sensor. *RSC Adv*. **2025**,*15*, 3738-3748.

[2] Alina Pilipencoa, Michala Forinováa, Zulfiya Černochováb, Zdeňka Kolskác, Hana Vaisocherová-Lísalováa, Milan Houska. The Effective Charge of Polybetaine Brushes. *Langmuir*, 2025 in press.