Influence of buffer pH and composition on wettability of modified surfaces

Jutta Lehnfeld[1], Verena Huber[1], and Rainer Müller[1]

[1] *Institute of Physical and Theoretical Chemistry, University of Regensburg, Regensburg, Germany*

Biomaterials have to be capable of effective tissue integration and should resist bacterial attachment [1, 2]. Those processes are strongly influenced by the physicochemical properties of the material surface [1, 3]. Thus, in this study the pH-dependent wettability of a variety of amino group-terminated surface modifications was investigated, in order to gain basic knowledge about the correlation between surface functionalizations and their properties.

For this study, silicon or silica model substrates were functionalized with organic molecules with terminal amino groups, but different structure (Fig. 1). The surface coatings were analyzed via static contact angle measurements with buffers of varying pH and composition (10 mmol L^{-1}, acetate at pH 4, phosphate at pH 6 and 7.5, carbonate at pH 9). In addition, PBS buffer (150 mmol L^{-1}, pH 7.5) was tested. Moreover, the modifications were characterized via an amino group detecting assay (sulfo-SDTB assay), IR spectroscopy and electrophoresis experiments.

In those initial contact angle measurements, the contact angle rose with increasing pH of the buffer. This can be expected because all modifications possess terminal amino groups, which are deprotonated at higher pH values. This observation was not valid for the carbonate buffer at pH 9. For this system contact angles decreased (compared to pH 7.5) for three coatings (APD, PPI-G4, PAMAM-G5), possibly indicating carbamate formation [4]. At last, the contact angles measured with PBS were considerably higher than the values at the same pH with the phosphate buffer. This effect was most pronounced for the PAMAM dendrimer coating, as the dendrimer's surface amino groups probably back-fold into the interior at higher ionic strength [5].

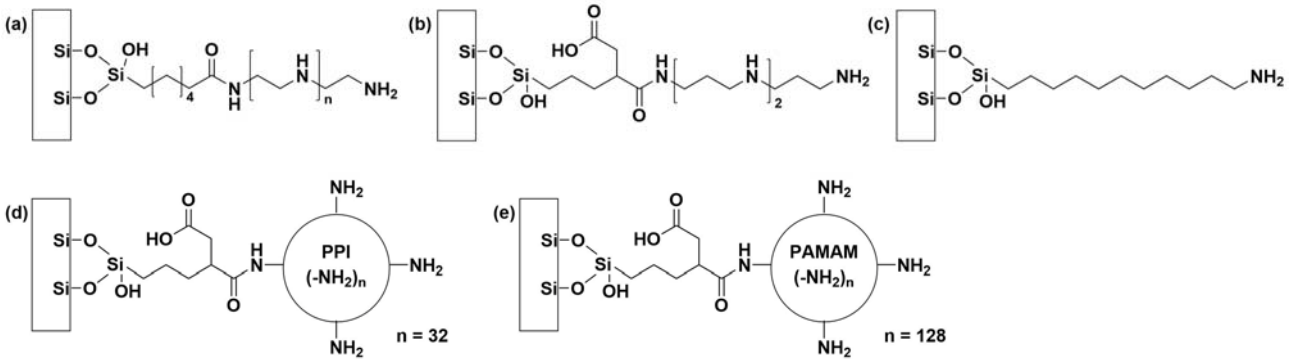

Figure 1. Overview of the surface modifications: (a) linear poly(ethylene imine) (PEI) polymer, (b) N,N' bis(3-aminopropyl)-1,3-propanediamine (APD), an oligo(propylene imine), (c) self-assembled monolayer with terminal amino groups (SAM-NH_2), (d) poly(propylene imine) dendrimers of generation 4 (PPI-G4), or (e) polyamidoamine dendrimers of generation 5 (PAMAM-G5).

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