Porous SiO*x* plasma polymer films as a versatile platform for multifunctional surfaces

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The development of multifunctional surfaces can help to address issues of current biomaterials regarding non-leaching antibacterial properties and control of protein adsorption, among others. SiO*x* coatings as deposited, e.g., from O_2/HMDSO plasmas provide a robust Si-O network with embedded organic hydrocarbon residuals [1]. While for barrier coatings the carbon content should be minimized, the residuals can be used to define the degree of nanoporosity of the plasma polymer films, allowing water diffusion due to formation of silanols [2]. Oxygen etching can remove the near-surface hydrocarbons by enhancing porosity. Therefore, a cyclic film formation, depositing a nanofilm followed by etching, is introduced to deposit highly porous SiO*x* films, when films thicker than ~10 nm are demanded. Unlike the used baking at high temperatures to obtain porous low-*k* materials, the used deposition/etching cycle is performed close to room temperature, thus allowing deposition on soft and temperature sensitive materials [3]. The porous SiOx films can be infused with a liquid such as polyethylene glycol (PEG) to obtain a slippery surface. Capping with a PDMS-like nanofilm, deposited from HMDSO plasmas without oxygen, enables the confinement of water molecules in the subsurface affecting protein adsorption [2].

Furthermore, catalytically active coatings can be covered by the porous SiO*x* film, still allowing water and oxygen diffusion to the catalyst [4]. The generation of highly reactive oxidative species (ROS) at the interface supports antibacterial activity, while permanent hydrophilic surfaces are obtained. Variation of the O_2/HMDSO ratio for the deposition of the cover layer, on the contrary, is used to adjust wettability and to add surface properties as discussed above. With this versatile platform at hand, novel combinations of surface properties can be realized.

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