Grafting poly ethylene glycol chains for antifouling purposes using supercritical CO_2

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Poly (ethylene glycol) (PEG) brushes are widely used for making antifouling surfaces[1]. High graft density, which is desirable for optimal antifouling activity can be achieved using techniques such as atom transfer radical polymerisation[2] (ATRP), cloud point grafting[1], and underbrushes formation. Here we demonstrate that PEG grafting using supercritical carbon dioxide ($scCO_2$) results in higher PEG thickness (figure 2) relative to ethanol or toluene based grafting in thiol or silane based grafting respectively. Adsorption of bovine serum albumin (BSA), lysozyme, casein and lactoglobulin (Lacto-G) on PEG grafted surfaces were quantified using quartz crystal microbalance (QCM-D) (figure 4) and x-ray photoelectron spectroscopy (XPS) (figure 3).

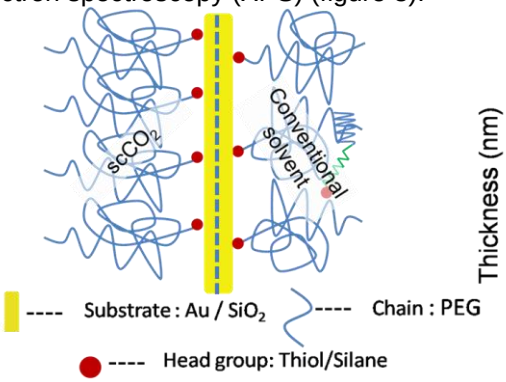

Figure 1: This schematic describing PEG grafted surfaces using $scCO_2$ (left) and conventional solvent like ethanol or toluene (right).

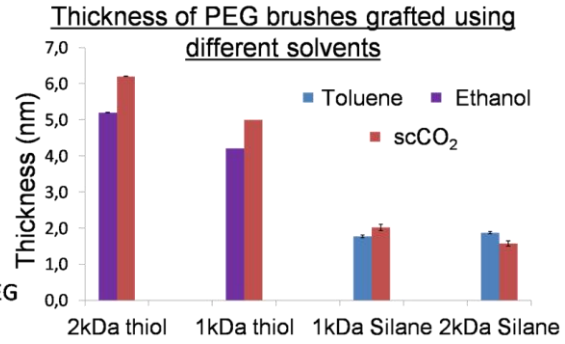

Figure 2: The relative thickness of PEG brushes grafted on gold using ethanol or toluene and $scCO_2$, calculated from XPS.

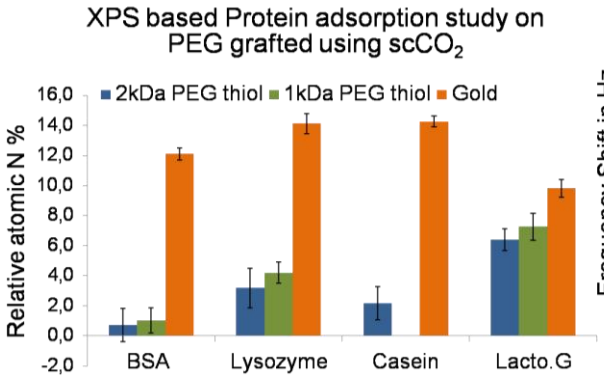

Figure 3: The graph shows XPS results of adsorption studies done (all 2 mg/ml, 24 hrs, 37˚C, N 1s peak), with BSA, lysozyme, casein and lactoglobulin, on 1 and 2 kDa PEG thiol grafted Au surfaces using $scCO_2$ and bare Gold.

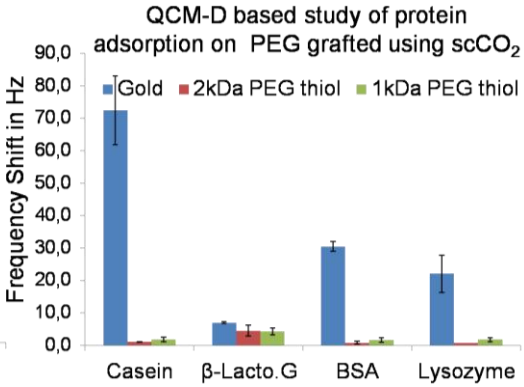

Figure 4: QCM plot of frequency shift (7th overtone, 2 mg/ml, 750 μl) upon exposure of BSA, lysozyme, casein and lactoglobulin, on 1 and 2 kDa PEG thiol grafted Au surfaces using $scCO_2$ and bare Gold.

In conclusion $scCO_2$ based PEG grafting resulted in surfaces that could significantly lower the adsorption of proteins and hence can be used as an efficient solvent in processes involving PEG grafting for antifouling purposes. Significant chemical efficiency and extremely low surface tension makes $scCO_2$ an apt solvent for Grafting PEG brushes into three dimensional micro or nano porous scaffolds related to tissue engineering.

References:

1. Peter Kingshott, Jiang Wei, Dorthe Bagge-Ravn, Nikolaj Gadegaard, Lone Gram, *Langmuir* **2003,** *19,* 6912.
2. Ning Luo, J. Brian Hutchison, Kristi S. Anseth, Christopher N. Bowman, *Macromolecules* **2002,** *35,* 2487

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