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Protein adsorption on nano-patterned hydrogenated amorphous carbon model surfaces

Predicting how proteins fold and adsorb onto surfaces is a complex problem of strong relevance to the health and environmental sectors. In this work, two nano-patterning techniques, namely focused ion beam (FIB) milling and atomic force microscopy (AFM) nanoindentation were used to develop hydrogenated amorphous carbon (a-C:H) model surfaces with similar nano-topography but different local composition. On the un-patterned surfaces, bovine plasma fibrinogen (BPF) resulted in a thicker and rougher adsorbed film than bovine serum albumin (BSA), although FTIR analysis indicated that, the secondary structure of the proteins changed similarly, with an increase of the β-sheet component (+27% and +34% for BSA and BPF, respectively). AFM analysis on the FIB-patterned surfaces indicates that patterning can modify specific protein adsorption behaviors. Moreover, the patterns were compared by imaging the AFM tip/surface adhesive force for BSA adsorbed on either AFM tips or patterned surfaces. The results show an electrostatic interaction between the implanted Ga+ and BSA surface, modifying the adsorption behavior and the adhesive force. Modeling this interaction gave an estimate of the surface charge per protein, a significantly lower value than in dilute solution (-1.8e instead of -18e). This finding is indicative of protein misfolding, as detected in the FTIR analysis.

Speaker Biography

Dr. Patrick Lemoine works at the Nano-Integrated Bioengineering center (NIBEC) of the Ulster University (UK). He graduated in 1989 from ENSPG-Grenoble (France), completed his Ph.D in 1992 in Trinity College Dublin (Ireland) and also worked at Turin's Polytechnic Institute (Italy). His research is on ultrathin film analysis, particularly using AFM techniques. He has attracted funding from the Royal Society and the Leverhulme Trust, takes part in both industrial and academic research projects and has been key note speaker and invited speaker at international conferences. He is a contributor to specialist books on carbon materials (CRC Press and Springer Verlag) and has over 61 publications in peer-reviewed journals (h-index=17). He was a Committee member of the IOP in Ireland (2002-2004) and is a member of the UU Research Ethics Committee.

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