Grafting biologically active polymer chains to polydopamine coatings for novel biosensor fabrication

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Recent research in the field of inexpensive, novel sensor materials has dealt with compounds displaying magnetoelasticity. Magnetoelastic materials are typically amorphous, ferromagnetic compounds which are capable of undergoing elastic deformation in response to a time-varying magnetic field. Furthermore, these materials are also magnetostrictive, that is as the materials mechanically deform, they will induce a magnetic field which can be registered by the simple use of a pickup coil (Figure 1). This simple technology, the use of magnetic fields to induce mechanical deformations, is already commercially available in several forms, and one example is a ribbon-alloy made by AlliedSignal Corporation and marketed as Metglas™. Manufactured in this form, the materials are readily used in the anti-theft market due to their effective monitoring range (upwards of several meters) and low production cost so as to make disposability viable.

The work of Grimes et al. have shown that the resonance frequency of these materials shifts linearly with respect to the dimensions of the sensor and the mass absorbed on the sensor. Thus, by keeping the same sensor size, magnetoelastic sensors have been used to interrogate biological and chemical systems, when a functional coating was employed, in a similar fashion as a quartz crystal microbalance (QCM). The polyurethane coatings employed exhibited simple glucose binding through the urethane linkages and also acted as a protective barrier for the magnetoelastic alloy preventing the sensor from corroding and degrading which would affect its usefulness and sensitivity. By incorporating polymer surface grafting techniques to these materials, the magnetoelastic sensor surfaces can be tailored to a far wider range of chemicals as well as increase the sensitivity of the sensor by increasing the number of functional binding sites.

To this end, we have researched depositing polydopamine onto the surface of these magnetoelastic strips so as to afford a high surface density substrate that is also environmentally protected. This also permits the facile functionalisation of the latent hydroxyl and secondary amine groups with initiators for “grafting from” polymerisation or “grafting to” of polymer chains containing carboxylic acid units.


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Research interests: surface modification, controlled radical polymerisation systems, novel biosensor devices