Bacteria face stiff competition

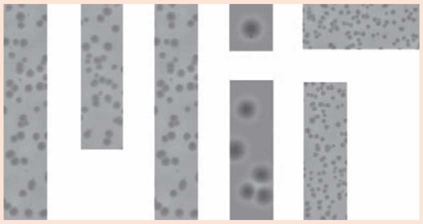
POLYMERS AND SOFT MATERIALS

Colonies of bacteria which grow on medical implants and other medical devices play a central role in the multi-billion dollar problem of antibiotic resistant infections.

In a development which could lead to safer implants for fighting biofilms, researchers from the Massachusetts Institute of Technology have uncovered the first evidence that bacteria preferentially adhere to stiffer polymers [Lichter *et al.*, *Biomacromolecules* (2008), doi:10.1021/bm701430y].

"Our work shows a strong, positive correlation between stiffness of the polymer surface and the number of bacteria colonies formed," explains Krystyn J. Van Vliet.

The researchers note that past research focused on killing microbes that have already formed biofilms, or impregnating surfaces with antimicrobial compounds. Although certain



MIT logo in which the different letters represent polymeric substrata of differing stiffness upon which bacteria colonies were grown. (Courtesy of Krystyn J. Van Vliet.)

surface conditions were known to affect biofilm formation, many results were in conflict, and the effect of the mechanical stiffness of these surfaces had not been considered.

Van Vliet stresses that her team has not investigated the exhaustive range of stiffness for materials with which bacteria interact: "We considered a particular range of stiffness, for specific polymers and bacterial strains, and showed that other important factors in bacterial adhesion either showed no correlation with colony density or were not statistically significantly different from surface to surface."

Based on these results, the researchers conclude that altering the stiffness of the polymers used in implants could lead to better materials for fighting or sustaining biofilm formation.

Van Vliet hopes her team can next identify the actual mechanism behind the remarkable behavior of the bacteria, and ascertain how general their observations are over wider ranges of polymer stiffness and various bacterial strains.

Andrea Taroni

New route to polymer-protein hybrid materials

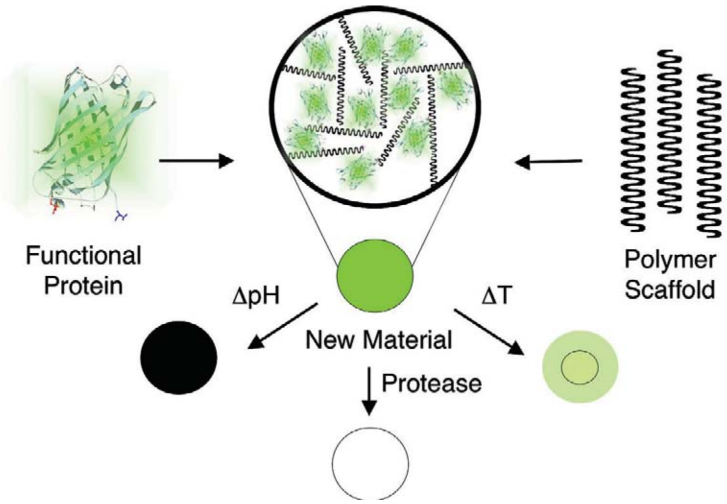
BIOMATERIALS

American researchers have developed a new method for creating polymer-protein hybrid materials that is completely general and suitable to any protein [Esser-Kahn and Francis, *Angew. Chem.* (2008), doi:10.1002/anie.200705564].

Polymer-protein hybrid materials have a large potential in the manufacture of sensors, nanomachine parts, and drug-delivery systems, since they combine the specific biological functions of proteins with the advantageous bulk and processing properties of plastics. However, current processes for their production rely on specific coupling techniques that are not suitable to all proteins.

"Simply put, we chemically coupled a protein into the structure of a gel in a manner which is independent of the nature of the protein. Our goal was to couple the three-dimensional structure functionality of a protein with the properties of a bulk material," explains Aaron Esser-Kahn, from the University of California, Berkeley.

Esser-Kahn and Francis took advantage of the fact that all protein chains have an amino acid group on one end and a carboxylic acid group on the other. By activating the ends using two parallel but mutually independent (orthogonal) reactions, the researchers were able to attach them to special 'anchor points' on the polymer. The proteins thus cross-link the polymer



Cross-linking polymer chains with polymers leads to new materials with structure dependent functionality. (Courtesy of Aaron P. Esser-Kahn.)

chains and form a solid, gelatinous material known as a hydrogel.

To demonstrate the efficacy of their technique, Esser-Kahn and Francis used a protein that fluoresces green to cross-link their polymer chains. Since the protein retains its folding pattern after being attached to the polymer, the fluorescence is also maintained, and the entire gel fluoresces green. The hybrid material also inherits other properties of the protein. For example, it is biodegradable, and is responsive to changes to pH and temperature.

The researchers point out the practical applications for materials that can respond to the environment in this fashion are significant. "We hope other researchers can use our method to include proteins into materials and thereby create hybrids with entirely new properties." says Esser-Kahn.

Andrea Taroni