Zero grip for bacteria

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Patients suffering from kidney problems cannot filter the blood to remove body wastes. Some even have to go to the hospital several times a week to undergo haemodialysis (cleansing of the blood) – something which is extremely time-consuming.

When a home dialysis treatment based on a catheter implanted in the abdominal cavity (PD-dialysis) became available, many patients were no longer so reliant on visits. However, bacteria and infections have been a major problem in PD, in many cases resulting in early catheter removal.

In 2001, six research partners (the Martin Luther University of Halle, the German research institute iba, the University of Genova, SINTEF, the Dutch catheter manufacturer Humeca and the Dutch test laboratory BioScan) joined forces to develop a surface to reduce bacterial adhesion and growth. The new coating may be used on all types of equipment where low bacterial adhesion to the surface is desired.

“We have used medical catheters as an example and have conducted all our tests on this product, but this research would be equally beneficial for production equipment in the food industry,” says SINTEF Research Manager Ruth Baumberger Schmid.

Special molecule

The University of Halle has a patent on the extraction and use of a special molecule for coating. The molecule is a fatty substance (lipid) that is produced by bacteria deep in coal mines. The research team based its work on this fatty substance. It was already known that the lipid had

properties that were beneficial for medical use: it does not create any toxic or allergic reaction or injury to either tissue or blood.

“The aspects of this lipid are that it consists of a double-chain and is rod-shaped, as well as being chemically and biologically stable,” says Schmid. “A tight layer of molecules will resemble a biological membrane, for example a cell wall. We tried to imitate a biological surface to which bacteria could not attach.”

Chemists at work

The catheter itself is made of silicon, a material known for being stable and harmless, because it does not reactwith other substances in the body. In order to bind the coating to the surface, the research scientists had to activate the silicon. One of the major challenges was to fasten the coating to the silicon without altering the silicon’s positive properties.

“As the lipid consists of a double-chain with reactive “heads” on both ends, we could bind the lipid to the catheter wall via the head at one end and at the same time attach other molecules to the “head” on the opposite side,” says Schmid. The research scientists tested different types of chemistry on the outermost “head”, and then prepared tailor-made surfaces with many different properties, including positive charge, negative charge, water-attracting, and water-repelling.”

The next step was to conduct a host of physical and biological tests at iba and BioScan on the various surfaces. The tests showed a pattern and confirmed that the research scientists had been successful: With a new surface on the catheter, the bacterial flora was reduced by half, and when favourable chemistry was applied to the molecule’s outermost heads, the reduction reached 75 percent. Moreover, no negative effects were observed when the surface came in contact with living organisms.

Further development

The University of Halle and iba have now established a company in Germany to find other applications for the lipids in addition to the catheter. SINTEF, iba and the University of Halle have also met with a South African mining company, which has lipids as a by-product.

“There is good and complementary co-operation among the three partners,” says Schmid. “While Halle conducts basic research on the lipid and iba handles the biological testing, we are focussing on applied research and can expand product offerings to include industrial applications.”

Source: SINTEF