Polymeric Antibacterial Films

Antibiotics have proven extremely useful in humankind's battle against bacteria since Alexander Fleming's accidental discovery of penicillin in 1929. However, the excessive and uncontrolled use of antibiotics in certain parts of the world has risen several problems because of the evolvement of antibiotic resistant strains. With overwhelming resources at the disposal of bacteria, this process is much faster and more efficient than a humankind ability to develop and introduce new drugs. The public health organisations in the well-developed regions (e.g., in Scandinavian countries) launched the public awareness programs sufficiently early to slow down this process. In other parts of the Globe, however, several even little harmful bacteria exposed to large doses of abused antibiotics had enough time to learn how to resist them. Consequently, some of them evolved into antibiotics-resistant "superbugs". Once acquired by one strain, this "know-how" can be passed to others (possibly more lethal or more infectious), which may also learn how to resist antibiotics. Consequently, even the very cautious societies with strict control of antibiotics applications are not safe. For example, one of the recent bacterial threats in the form of beta-lactam antibiotics-resistant strain of *Klebsiella pneumonia* ("New Delhi superbug") has been identified in Sweden, where it had been brought probably from India.

The problem of antibiotic-resistant bacteria will not vanish and will certainly continue causing serious trouble for the healthcare in the coming decades. One way to continue in this battle is certainly developing new antibiotics. Nevertheless, in response to them bacteria will always find effective ways to neutralise them. An alternative way to fight bacteria at early stages of their invasion is to mimic the natural defence system of living organisms, based on simple non-specific antimicrobial peptides (AMP). Paradoxically, because of the non-specificity of this kind of antimicrobial activity, AMP-like molecules can become better alternatives than antibiotics. They do not require any specific recognition sites to attack a pathogen, and are mobilised at low energetic cost shortly after an infection, before the lengthy process of specific immune response is deployed by the attacked organism. Their action relies on simple nonspecific electrostatic attraction between the negatively charged bacterial membrane and the positive end of the peptide, combined with hydrophobic interaction necessary to incorporate into the bacterial membrane. In contrast to antibiotics, which must penetrate the bacterial cell through some specific receptors in order to alter the cell functioning, the antibacterial peptides simply perforate and permeate the bacterial membrane. The simplicity of their action drastically reduces the possibilities to develop any resistance by the bacteria. Inspired by this simplicity, we plan to synthesize and investigate a series of polymers bearing positively charged functional groups. The thin films formed by these positively charged polymers will be tested as potential antimicrobial surfaces using model pathogens.