Orchestrated Attachment of Antibiotic Monolayers to Surfaces; Stimuli-Responsive Inhibition of Bacterial Proliferation

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ABSTRACT

Without antibiotics our society would suffer many losses of lives. Although polymeric materials have allowed the development of many life-saving devices that do not interfere and often work in harmony with biological functions, surfaces of implants or other devices in contact with bio-environments are not exempted from bacterial attacks, thus leading to undesirable and often detrimental infectious. In an effort to inhibit microbial bio-film formation orchestrated synthetic efforts resulted in the development of a new platform of surface reactions that involve microwave plasma in the presence of maleic anhydride and attachment of a variety of molecular spacers terminated with antibiotic molecules. These species form dynamic nano-surface assemblies with attached penicillin, ampicillin, gentamicin, and other species at one end, while being anchored on the other to inert, low surface tension polymeric surfaces, such as extended polytertrafluoroethylene (e-PTFE) and polypropylene (PP). These nano-assemblies effectively inhibit microbial film formation and bacterial proliferation of gram-positive (*Staphylococcus aureus, Bacillus thuringiensis,* and *Enterococcus faecalis)* as well as gram-negative (*Escherichia coli, Pseudomonas putida,* and *Salmonella enterica*) bacteria. While the above studies focused on surface self-assemblies on plain polymeric surfaces, another approach was developed that utilizes self-assembled phospholipids (PL) and redox reactions in an aqueous phase, which upon crosslinking form nano-spheres and nano-tubular shapes. These materials exhibit extraordinary ferromagnetic properties at room temperature and their exterior surfaces were also decorated with antibiotic monolayers targeted at gram positive and gram negative bacteria, thus providing stimuli-responsive characteristics.