Contribution ID : **66** Type : **not specified**

Natural and bio-inspired antibacterial surfaces

Tuesday, 20 May 2014 16:50 (20)

Nature has developed numerous strategies for coping with bacterial infection. One such strategy, employed by insects, involves killing any cells that may attach to their wings by means of complex nanostructures. Cicada dragonfly wings are both covered by an array of nanopillar-type structures that vary in their spatial patterning. In both cases the nanopillars rupture and kill bacterial cells, however dragonfly wings are effective against a wider range of bacterial species. Based on this concept, we tested black silicon (bSi), a plasma-etched material originally developed for photovoltaic applications, and found that bSi possesses similar nanostructures to dragonfly wings, and accordingly produces a similar bactericidal effect. These surfaces represent the first known examples of mechanobiocidal activity; i.e. surfaces that kill cells through mechanical action alone with little or no influence from surface chemistry. Our most recent work has centred on the development of a new generation of mechanobiocidal surfaces, based on the components naturally found in dragonfly wings. Recystallisation of fatty acids on graphite produces ordered microcrystal interfaces which are also able to inactivate bacterial cells. These fatty acid-derived surfaces combine facile synthesis with inexpensive materials, which will be of great benefit in a variety of antibacterial applications.

Summary

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Session Classification : Session 4: Applications of Infrared Microscopy to Studies of Biology and the Nanoscale