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Biomineralization in Marine Environments

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In marine environments microbial biofilms form on all surfaces exposed to environmental conditions conducive for microbial colonisation and growth. Microorganisms thriving within such biofilms are physiologically diverse and able to change interfacial chemistry at the colonised surface by carrying out a range of reactions. These include the consumption of oxygen, production of acids, sulphides and release of exoenzymes. When present on metallic surfaces biofilms can cause deterioration, termed biocorrosion, or protection of the underlying substratum. A number of mechanisms have been identified reflecting the variety of physiological activities carried out by biofilm micro-organisms that promote the establishment of localised chemical gradients at the metal surface, including biomineralisation. It is recognised that crystalline and amorphous minerals can be formed as a result of interaction at the macromolecular level of living and non-viable biofilm components with divalent cations. On metallic surfaces, the accumulation of metal ions in different oxidation states within biofilm matrix leads to the formation of metal concentration cells and promotes electron transfer processes within biofilms. Such chemical gradients lead to the development of electrochemical cells, which influence anodic and/or cathodic reactions, the ultimate consequence being loss of metal from the discrete locations on the surface.

Biomioneralisation in any particular biofilm system is seldom linked to a unique mechanism or to a single microbial species and is typically due to complex biofilm/ metal ion interactions on the material surface. Understanding such interactions is, therefore, of paramount importance when developing effective biofi

This communication will discuss importance of biomineralisation in facilitating mi-

crobial attachment to surfaces, i.e. in the initial stage of a biofilm formation, expanding to the concept of electron conductive nanowires in marine habitats. Emphasis will be placed on the involvement of extracellular polymeric matrix (EPS) in the mineral formation and examples provided based on (i) the study of interactions of EPS with Ca (II) ions and (ii) bacterial biofilms with copper-bearing surfaces using advanced microscopy and surface science methods, such as field emission SEM/EDX, X-ray photoelectron spectroscopy and atomic force spectroscopy.