Bacterial Adhesion on Optic Waveguide Thin Film

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Abstract

Bacterial adhesion is an important issue to the unknown transmission of pathogens nowadays. Therefore, there is an intense interest in speeding up the determination of microbial pathogens. The principles of bacterial adhesion are beginning to be understood at the kinetic level in the past few years, nevertheless, the crucial aspects to be taken into consideration are the spatial arrangements of molecules or atoms at the interacting surfaces and the profiles of the interfacial forces. In this study, the adsorption kinetics of Escherichia coli strain K12 to biomaterial metal oxides silica (SiO2) and zirconia (ZrO¬2) differing in their interfacial energy parameters were measured with high accuracy and precision using optical waveguide lightmode spectroscopy (OWLS) at various dilutions in phosphate buffered saline. Optical waveguide lightmode spectroscopy is a label free technique for providing the high accuracy kinetic data required with excellent time resolution. This enabled us to probe hence understand the process involved in bacterial adhesion at nanometric precision. The results showed that the bacteria adsorbed irreversibly with the kinetics of random sequential addition. Analysis of the kinetics enabled key parameters to be extracted, notably the adsorption rate coefficient and the area occupied per bacterium. The adsorption rate coefficient was compared with the values calculated from independently measured surface tension parameters of the bacteria and oxides. It was demonstrated that small changes in solvent composition dramatically affected the adsorption. Hence the adsorption behaviour to smooth uniform surfaces is clearly closely linked to the interfacial free energy (ΔG_{123}) which determines the initial approach to and attachment at the surface by the bacterium.

Keyword：bacterial adhesion, kinetic, interfacial free energy, optical waveguide lightmode spectroscopy