Successful adhesion on wet surfaces is one of the most important challenges in today’s biomedical engineering. Marine fouling organisms exhibit effective adhesion for wet substrates, and the measurement of adhesion forces in wet conditions is the first step toward mimicking the smart strategies of the marine organisms. Surface forces apparatus (SFA) is one of the most powerful nanomechanical tools used to directly measure time- and distance-dependent interactions between biological macromolecules or biological surfaces in an aqueous medium at the molecular level. Recently, SFA has been adapted to probe the biomechanical nature of the underwater adhesive in marine organisms. This presentation describes three strategies of the marine fouling organisms for successful underwater adhesion determined using by SFA.

**Key words** adhesion molecules, catechol, surface forces apparatus, cation-pi interaction

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Structural and functional features of microbial cell-immobilizing protein AtaA

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*Acinetobacter* sp. Tol 5 exhibits an autoagglutinating nature and noteworthy adhesiveness to various abiotic surfaces from hydrophobic plastics to hydrophilic glass and stainless steel\(^1\). Tol 5 cells have the novel trimeric autotransporter adhesin (TAA) designated AtaA (*Acinetobacter* TAA), which is responsible for the adhesive nature of Tol 5\(^2\). Unlike adhesion of usual bacteria forming biofilms, AtaA mediates adhesion of resting cells, independent of cell growth. Analyses of the adhesion process under optical microscopes suggested that autoagglutination of bacterial cells mediated by AtaA greatly contribute to cell immobilization onto material surfaces. AtaA consists of 3,630 amino acid residues, follows the general N-terminus-head-stalk-membrane anchor-C-terminus organization of TAs, and has an additional head domain at the C-terminal region. TAs have been reported to mediate bacterial adhesion to host cells and/or extracellular matrix proteins, and autoagglutination\(^3\). However, there has been no report about such nonspecific, high adhesiveness to abiotic surfaces as AtaA mediates. This adhesion property can be conferred to other bacteria by transformation with the ataA gene\(^4\).

For characterization of the AtaA passenger domain (PSD), which is translocated and displayed at the cell surface through the C-terminal anchor domain, a HRV3C protease recognition site was inserted at the base of the PSD, which was cut down for separation and purification. The fibrous structure of the PSD was observed under a transmission electron micrograph (TEM). The stability profiles of the PSD against heat and pH shift were analyzed by circular dichroism (CD) spectrometer and TEM. Affinity of the AtaA PSD to the abiotic surface was also measured using a quartz crystal microbalance (QCM) apparatus. We are also challenging to determine the 3D-structure of AtaA. Many recombinant fragments of AtaA have been carefully designed, constructed, and produced in *Escherichia coli* cells. Obtained fragments were subjected to screening for crystallization. We have succeeded in crystallizing some of them and solving their structures. Here, crystal structures of AtaA domains will be presented, showing the interesting feature on its structure.

**References**