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Single molecule force spectroscopy reveals the adhesion mechanism of hydrophobins YI CAO, BING LI, MENG QIN, WEI WANG, Nanjing University — Hydrophobins are a special class of amphiphilic proteins produced by filamentous fungi. They show outstanding interfacial self-assembly and adhesion properties, which are critical to their biological function. Such feature also inspires their broad applications in bio-engineering, surface modification, and nanotechnology. However, the biophysical properties of hydrophobins are not well understood. We combined atomic force microscopy based single molecule force spectroscopy and protein engineering to directly quantify the adhesion strength of a hydorphobin (HFB1) to various surfaces in both the monomer and oligomer states to reveal the molecular determinant of the adhesion strength of hydrophobins. We found that the monomer HFB1 showed distinct adhesion properties towards hydrophobic and hydrophilic surfaces. The adhesion to hydrophobic surfaces (i.e. graphite and gold) was significantly higher than that to the hydrophilic ones (e.g. mica and silicon). However, when self-assembled monolayers were formed, the adhesion strengths to various surfaces were similar and were ubiquitously stronger than the monomer cases. We hypothesized that the interactions among hydrophobins in the monolayer played significant roles for the enhance adhesion strengths. Extracting any single hydrophobin monomers from the surface required the break of interactions not only with the surface but also with the neighboring units. We proposed that such a mechanism may be widely explored in nature for many biofilms for surface adhesion. May also inspire the design of novel adhesives.

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