instituto imdea nanociencia

How much force is needed to kill a single bacterium?

Cristina Flors, Advanced Fluorescence Nanoscopy Laboratory
IMDEA Nanociencia
cristina.flors@imdea.org
https://imdeananotools.wixsite.com/flors

Mechano-bactericidal nanomaterials rely on their mechanical or physical interactions with bacteria and are promising antimicrobial strategies that overcome bacterial resistance to classical antibiotics. However, the underlying killing mechanisms are poorly understood. Our laboratory has combined fluorescence and atomic force microscopy to quantify the forces necessary to inflict mechanical damage on a single bacterial cell (Figure 1) [1]. Complementary fluorescence labelling strategies were used to probe the bacterial response to different ranges of external force and in real-time. The required force for the mechanical rupture of the bacterial cell wall of the Gram negative bacterium *Escherichia coli* is estimated as 20 nN, which separates two regimes of interaction: one that leads to instant bacterial death, and another one that characterizes low force collisions between bacteria and nanomaterials. The TFM project aims at performing similar experiments with the Gram positive bacterium *Bacillus subtilis*. It is expected that the dramatic difference in cell wall composition between Gram positive and negative bacteria will have a significant impact on the required rupture force. Overall, this project contributes to a quantitative understanding of the complex interaction between bacteria and nanomaterials.

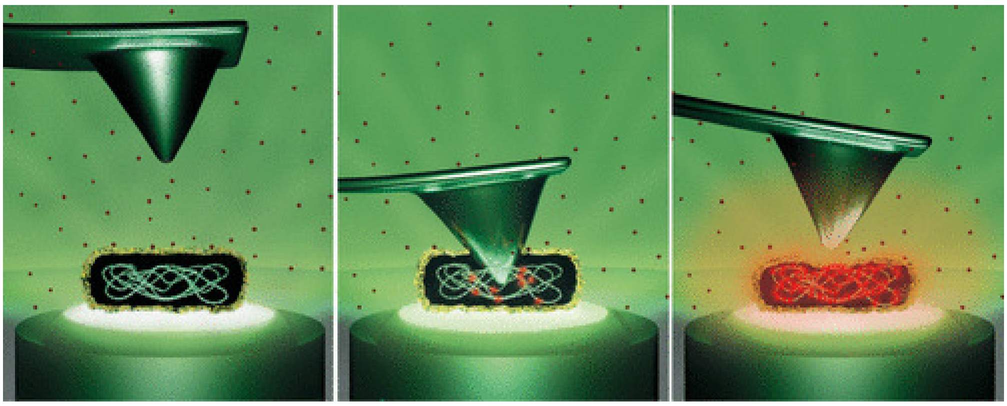

Figure 1. Experimental Strategy for Simultaneous AFM Nanoindentation and Fluorescence Imaging of Immobilized E. coli. Red dots represent PI molecules that are nonfluorescent in solution and light up upon DNA intercalation after cell wall damage

[1] A. del Valle et al, *ACS Appl. Mater. Interfaces* **2020**, 12, 31235.