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The adhesion of bacteria to austenitic stainless steel with different surface roughness

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The adhesion of bacteria to surfaces is an important biological process governed by the material surface properties (chemical composition, roughness, topography and surface energy), bacterial properties (surface charge, hydrophobicity, cell size, possession of flagella and pili) and the properties of the environment (temperature, flow, composition and ionic strength of the aqueous medium) [1-3]. The presence of bacteria on the surface enhances corrosion of material and presents chronic source of microbial contamination in medical and food industries [3-7].

The aim of our research was to examine the effect of different surfaces of austenitic stainless steel AISI 316 L on the adhesion of bacteria (*Escherichia coli* DH5 alpha) using field emission scanning electron microscopy (FE-SEM) and atomic force microscopy (AFM). The surface topography and roughness have been widely discussed as parameters influencing bacterial adhesion. We assumed that surface roughness correlates with the density of adhered bacteria. By using different surface treatments (grinding, polishing) on austenitic stainless steel different surface roughness (R_a) values and topographies (Aizv, A100, A320, A800, A1200, Apol) were achieved.

Surface characterization was made by Auger Electron spectroscopy (AES), x-ray photoelectron spectroscopy (XPS), AFM and contact angle goniometer. Samples were exposed to suspension of bacteria and the non-adhering bacteria were removed by rinsing the substrate with sterile phosphate buffered saline (PBS). Samples were then prepared for SEM observations regarding the distribution and the number of adhered cells.

As expected, the number and distribution of the attached bacteria varied among different samples. However, we did not entirely confirm our assumption. First results show that the least bacteria was on A800 sample (R_a=0.08 µm), attachment to both smoother and rougher surfaces was higher. The bacteria usually attach to the vicinity of the previously attached bacteria, so that they form clusters (Figure 1). The bacteria prefer scratches, cracks and surface irregularities over the smoother surface as they can provide shelter from unfavourable environmental factors (Figure 2, 3).

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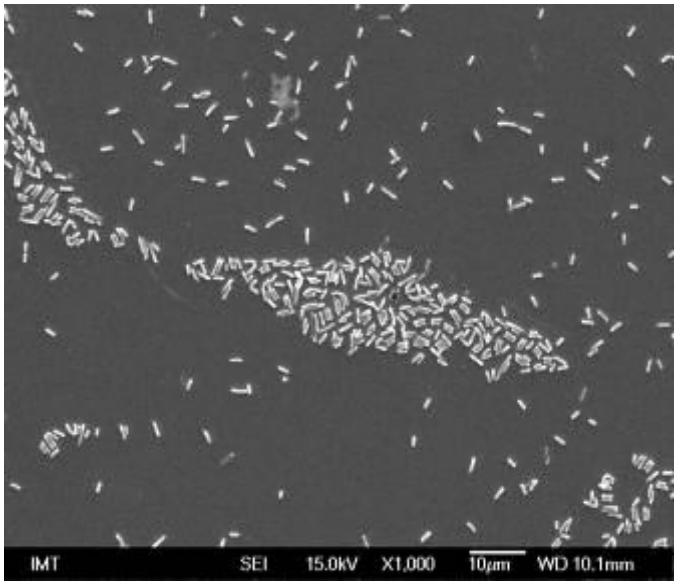

Figure 1. SEM image of attached *E. coli* to stainless steel sample Apol (polished surface).

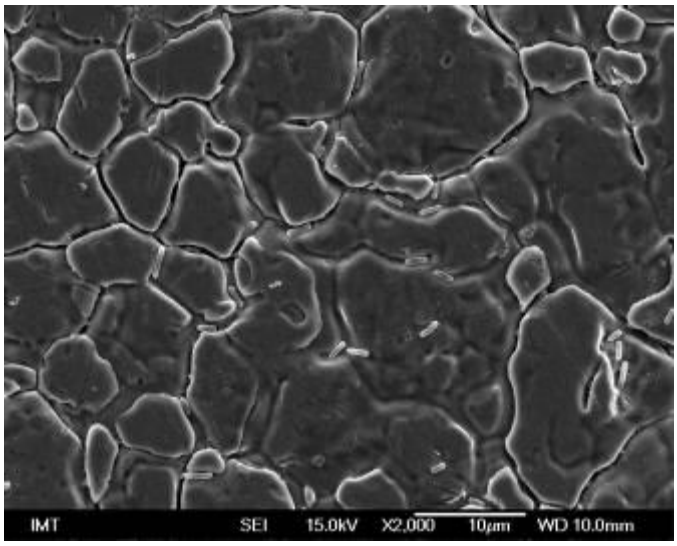

Figure 2. SEM image of attached *E. coli* to stainless steel sample Aizv (as received).

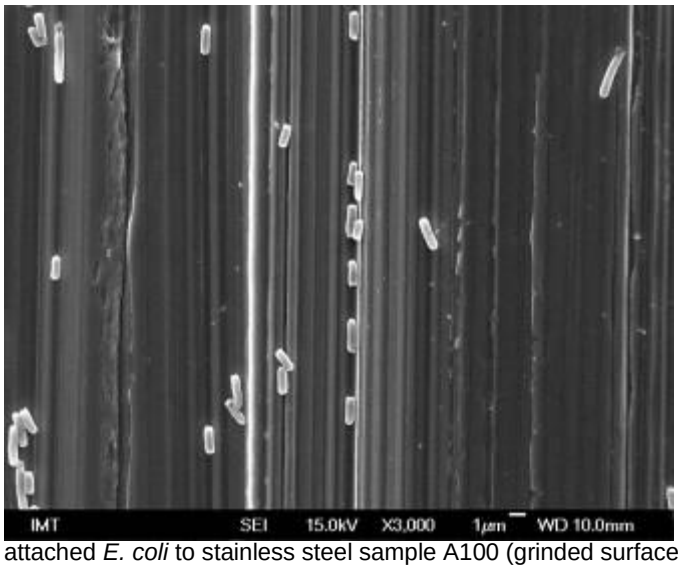

Figure 3. SEM image of attached *E. coli* to stainless steel sample A100 (grinded surface with grit P100)