

Minimising Milk Protein Adhesion: A Transient Surface Treatment of Stainless Steel



brilliant
Ideas
at work

Dr Ashok Parbhu

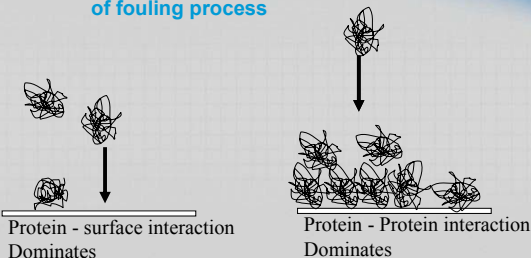
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Controlling Surface Functionality

- Controlling the functionality of metallic surfaces in a wide range of environments where surface fouling can cause problems
- Development of a screening tool to measure initial rates of fouling
- Surface treatments that confer resistance to milk fouling
- Understanding mechanism of fouling resistance
- NZ Foundation for Research Science and Technology funded program

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Surface influence on the initial stages of fouling process

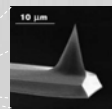
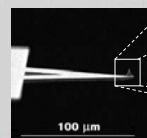


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Advance in Surface Science: Atomic Force Microscopes (AFM)

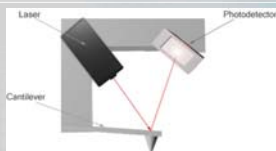


- Molecular Imaging PicoScan
 - Controlled fluid environment
 - Physical Interaction

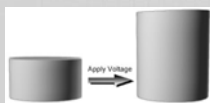


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Principle of AFM Technique



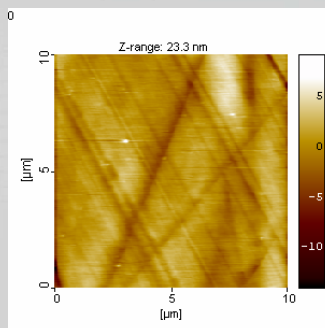
The light lever sensor uses a laser beam to monitor the deflection of the cantilever. When the cantilever moves up and down, the light beam moves across the surface of the photo-detector.



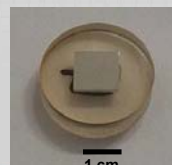
When a voltage is applied to the top and bottom surface of the piezoelectric disc, the disc will expand.

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Substrate Image

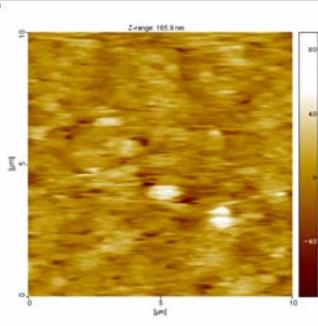


Topography Image
polished stainless steel
surface



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Fouled Substrate Image

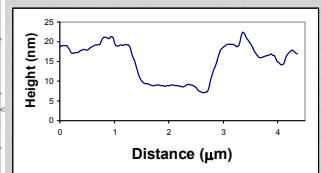
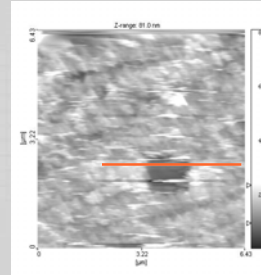


Topography Image of stainless steel surface post-fouling.

β -lactoglobulin
(10% WPI @ 350K
for 20min)

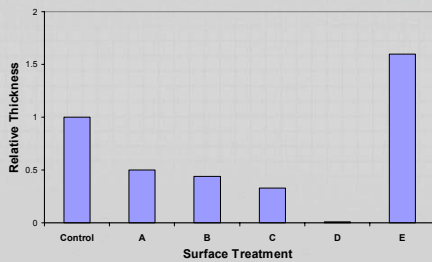
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Force “dissected” fouling layer



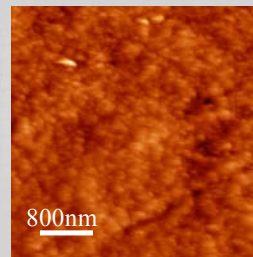
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Normalised Initial Fouling Depth

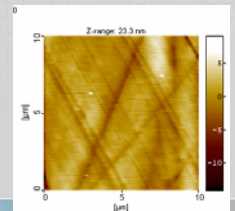


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What has Changed?



Topography Image of stainless steel Following pre-treatment D



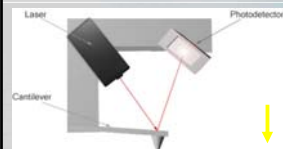
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Treatment development

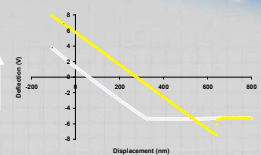
- Developed a transient treatment for stainless steel that reduces the initial rates of milk protein adhesion
- What is the mechanism of adhesion reduction

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Colloidal Force Microscopy

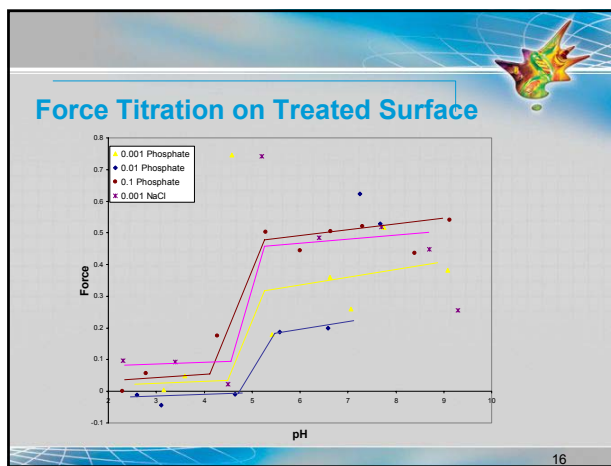
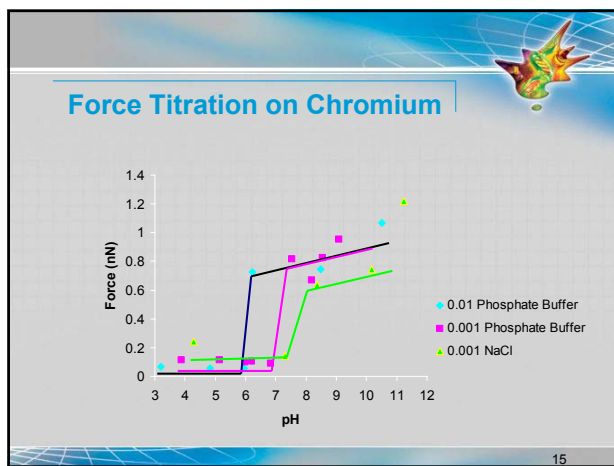
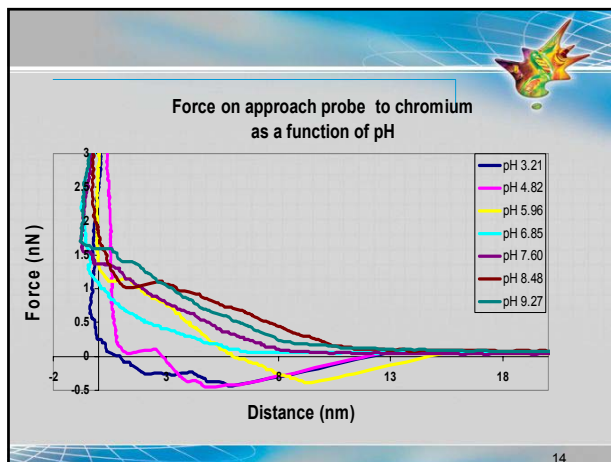
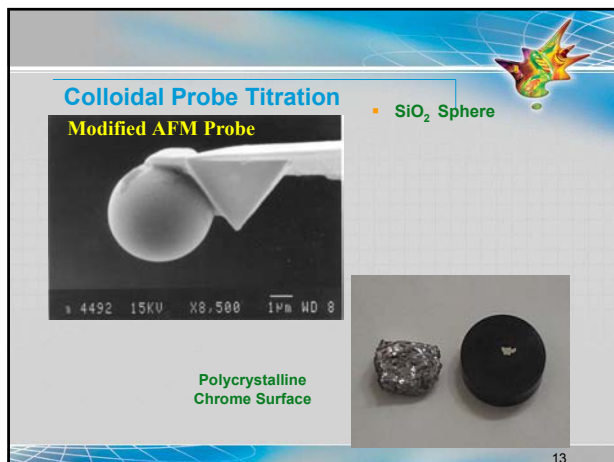


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$$F = k \cdot x$$

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Summary

Suggests transient surface treatment is removing binding sites on metal oxide surface for phosphate ions. The result of which is a reduction the initial fouling rates.

Future Work

Industrial scale testing of the transient surface treatment.

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