Atomic force microscopy (AFM) for food analysis

Identification

Key words
Atomic force microscopy (AFM), MFP 3D, microscopical technique, nanoscale imaging, surface imaging, topography, surface potential imaging, adhesion forces, force distance curves, force spectroscopy, lithography, scanning probe microscopy

Latest version
2012/07/17

Completed by
DIL

How does it work?

Primary objective
Analytical tool for determining surface properties (like topography and adhesion forces), surface potential imaging, force spectroscopy, lithography and/or phase imaging
**Working principle**

Atomic force microscopy (AFM) is a technique based on the measurement of interactions between a sharp tip and the surface being characterized [1]. The tip is moved across the surface from certain distances, or directly in contact with it, depending on what surface properties that are being determined. The surface remains intact and will not be damaged.

The surface is scanned with a mechanical probe called cantilever. The cantilever's deflection is detected by a focused and reflected light beam which hits a photodiode acting as a position sensitive detector (PSD). This signal is transferred to a computer and converted into a height image. Piezoelectric elements facilitate tiny but accurate and precise movements for scanning, which results in topographic images in the range of up to a few tenths of a nanometer.

**Images**

**Additional effects**

Besides visualizing surface topography (2D and 3D) and in contrast to other microscopically techniques, AFM offers the opportunity of measurements concerning surface polarity or adhesion forces of a surface [2,3]. Furthermore, molecular size, firmness as well as intermolecular interactions of polysaccharides for gelation, swelling or stabilization can be determined in special scanning modes [4,5].

**Important process parameters**

force spectroscopy, lithography, phase imaging

**Important product parameters**

Surface topography, adhesions forces, surface potential imaging
What can it be used for?

**Products**
Surfaces of solid parts and solid parts in liquids; solid-liquid, liquid-liquid or solid-gaseous interfaces e.g. example starch granules, ice crystals in ethanol, oil droplets in water (emulsions), bacteria and spores.

**Operations**
Surface imaging
Nanoscale-imaging

**Solutions for shortcomings**
Analysis of microscopical food structure at the nanometer scale before, after and during food processing to improve e.g. textural properties or to get information on surface topography

What can it NOT be used for?

**Products**
Gases

**Operations**
Measurement temperatures below -50°C and higher than 130°C are not possible, because of the limitation of the system.

**Other limitations**
In some cases high temperatures in the sample holder, electric discharges by laboratory staff can damage very sharp and small expensive tip during preparation for measurements

**Risks or hazards**
Eventual use of harmful solvents

Implementation

**Maturity**
This method is commercially available and already used in research as an analytical tool, also in food research [6].

**Modularity /Implementation**
Off line analytical method

**Consumer aspects**
Not applicable

**Legal aspects**
No legislation available

**Environmental aspects**
In some cases, harmful solvents can be used

Facilities that might be interesting for you

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<th>Title</th>
<th>Institute/company</th>
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<tr>
<td>Field Flow Fractionation INPT - El Purpan</td>
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<td>Fruit &amp; vegetable analysis INRA</td>
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<td>Multi-user olfactometer INRA</td>
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Further Information

**Institutes**
DIL, IFR, INRA, Unilever

**Companies**
Agilent Technologies, JPK Instruments

**References**

Source: