

# Active Nano Mapping Facility

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The ANM Facility, based at the University of Bristol, hosts the world's fastest atomic force microscope, a high-speed AFM. The microscope is housed in a dedicated active lab capable of handling samples up to a contact dose of 50  $\mu\text{Sv/hr}$  (or higher if the safety case can be made). Full glovebox facility enables the processing and imaging of samples without exposure to ambient conditions.

## About the microscope

HS-AFM is a Bristol Nano Dynamics Ltd. contact mode AFM that can collect video rate topography maps of surfaces with sub-atomic height and nanometre lateral resolution in ambient, controlled gas, and controlled liquid environments. The system has significantly higher throughput when compared to a conventional AFM, being able to collect and process a year's worth of AFM data in a matter of hours. This can be used in three main ways:

1. *To observe dynamic nano and micro scale processes in controlled liquid, gaseous, inert or ambient environments*

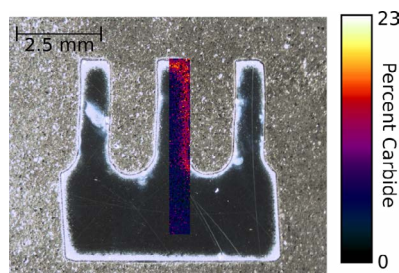
Easy-to-use navigation software and the ability to image under *in-vivo* conditions allows the ANM Facility to observe processes such as corrosion, oxidation, or cracking with sub nanometre resolution and frame rates up to 100 frames per second. The imaging window can be easily moved around the sample to find structures of interest. It is often the case that the nanoscale structures of interest are not homogeneously distributed on a surface and that most of the challenge in their measurement is in locating them in the first place. HS-AFM has proven itself to be the perfect tool for this task. To aid in this process optical images are collected simultaneously with topography and stored with the metadata.

2. *To map areas millimetres in size with nanometre resolution*

The HS-AFM can make use of the high frame rate by moving between frames to build up a composite image. This allows areas up to millimetres in size to be imaged without a reduction in resolution.

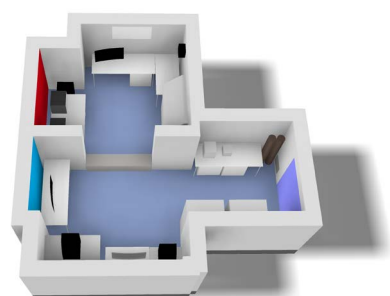
3. *To collect spatial maps of the distribution of the physical dimensions of nanostructures with world-leading statistical validity over centimetre sized areas.*

The imaging window can be moved across the sample surface in an automatic fashion in order to collect a sparse data set of thousands of frames in a matter of minutes. Custom software then characterises over 80 physical properties of every identified nanostructure on the surface. The processing can be filtered to only measure the nanostructures of interest. The spatial distribution of the nanostructure of interest can then be mapped on top of a calibrated macro image to enable a complete understanding of the macro scale distribution of nano and micro scale structures. The example shown left maps the carbide content in a 9 chrome steel boiler component. This process could also, for example, give you the distribution of mean diameter for all nanostructures orientated at between 30 and 50 degrees and below 2 microns in size.



The distribution of carbides in a cooling fin as measured by HS-AFM and processed on the NanoMapper software package.

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Data from Liu et al.



A render of the ANM NNUF Laboratory at the University of Bristol showing the active (red) and non-active (blue) sections.

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## Contact details

Please contact us for more information so that we might help you plan your experiments using the active HS-AFM in the ANM NNUF at the University of Bristol.

Please email [Oliver.Payton@bristol.ac.uk](mailto:Oliver.Payton@bristol.ac.uk) for more information

## Availability

The Active Nano Mapping Facility is currently scheduled to be available for access by external users from mid November 2020. Please reach out to the Active Nano Mapping Facility team, to start discussing access, at any point. Up-to-date information about availability, in light of the COVID situation, is available at [www.nnuf.ac.uk/active-nano-mapping-facility](http://www.nnuf.ac.uk/active-nano-mapping-facility).