Nanoscale Subsurface Imaging Method via SNFUH

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Technology description

A novel nondestructive imaging method (SNFUH) providing nanoscale spatial resolution as well as depth information for embedded structural features.
#medicaldevice #imaging #equipment #researchtool #method #photonics #holographic
There is an increasing need for nondestructive high-resolution imaging of various "buried" nano/micro-structures in scientific research and nano/micro-manufacturing process.To fill this critical void, a novel acoustic holography technology, known as the scanning near-field ultrasound holography (SNFUH), has been developed at Northwestern to provide nondestructive real-space imaging of embedded features with nanoscale lateral resolution and depth sensitivity. This invention is based on a unique integration of scanning probe microscope (SPM) platform coupled to microscale ultrasound source with novel detection and holography techniques. The ultrasound wave needed for this imaging technology is generated during the thermal expansion of the samples that absorb the coherent laser beam provided. Significantly outperforming alternative approaches (e.g. AFM) in imaging resolution, SNFUH is equally amenable to hard (e.g. semiconductor), soft (e.g. polymers and biological system), and hybrid materials. This promising technology offers a versatile tool for numerous imaging and structure detection applications in physical sciences, engineered systems, and biology.

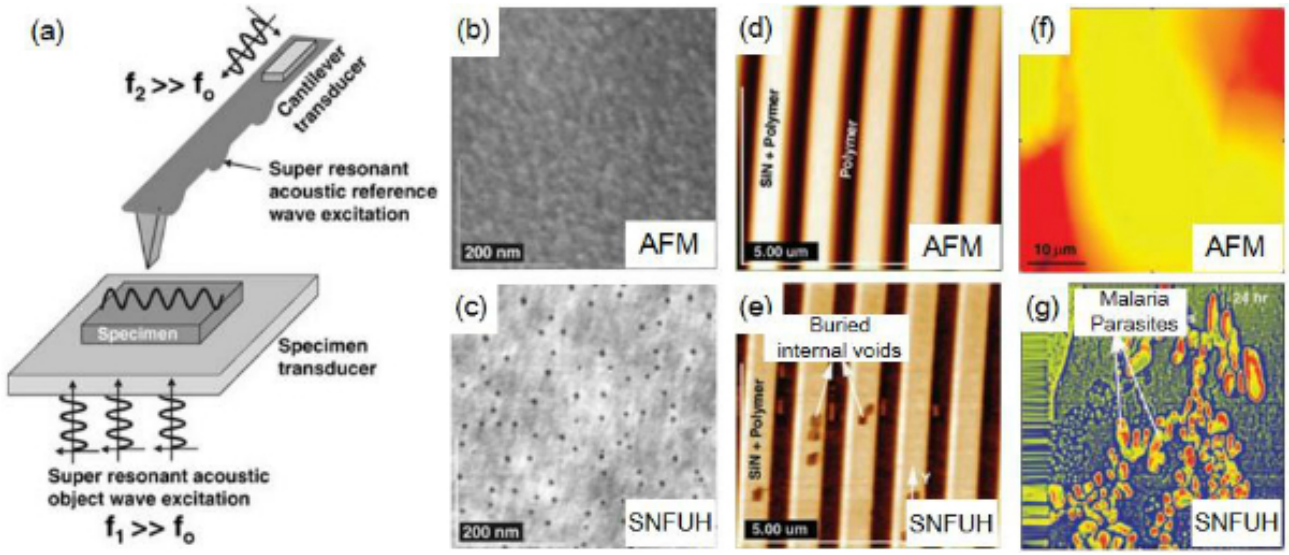

Figure Nanoscale imaging of surface using SNFUH and comparison with AFM. (a): Schematic illustration of the SNFUH approach. (b, c): For a system with gold nanoparticle buried under a polymer surface, a typical AFM topography image shows a featureless top polymer surface, whereas SNFUH

clearly reals the buried nanoparticle with high definition. (d, e): SNFUH clearly reveals the internal structural defect as the buried voids, whereas AFM only shows the top coating. (f, g): For a biological sample of red blood cells (RBCs) infected with malaria parasites, AFM shows the typical surface feature of RBCs, in contrast with SNFUH revealing the inside parasites with nanoscale resolution.

Publications

Shekhawat GS, Dravid VP (2005) Nanoscale Imaging of Buried Structures via Scanning Near-Field Ultrasound Holography,Science,310: 89-92.

Application area

Nondestructive nanoscale imaging of buried features in engineered systems, such as packaged nano/micro-electronics,
High resolution imaging of 3D nano/micro structures (hard, soft or hybridmaterial systems),
Nondestructive nanoscale imaging of inside structures of biologicalsystems, such as cells,
Nondestructive detection of internal structural defects at nanoscale.

Advantages

Nano-scale spatial resolution
Nondestructive, real-space imaging
Amenable to different material systems
Providing depth information

Institution

Northwestern University

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