Scanning Resonator Microscopy

Summary:
This invention consists of a new hyphenated atomic force microscopy (AFM) technique with whispering gallery mode sensing (WGM), which provides the ability to measure the topography and refractive index of a material simultaneously.

Overview:
Scanning probe microscopies encompass a multitude of techniques capable of probing surfaces with high spatial resolution. This hybrid technique combines refractive index sensing of whispering gallery mode resonators with the topography mapping capabilities of atomic force microscopy. AFM technique revolves around sensing mechanical forces between the tip and the sample and has been used to measure samples ranging from solid-state materials to soft biological tissues. Refractive index is a fundamental parameter of materials and is commonly used to monitor binding events at surfaces. The use of WGM sensing overcomes complications associated with other combinations of AFM with refractive index sensitivity.

Application:
Material characterization, sensing applications where binding events are quantified. Memory storage, thin film characterization, surface assay sensing, array sensing.

How It Works:
WGM sensing is integrated with AFM. A WGM resonator is integrated to the end of a conventional AFM cantilever, to allow simultaneous mapping of surface refractive index and topography.

Benefits:
The hyphenated technique provides for the simultaneous measurement of surface topography and refractive index, a fundamental property of the material. The result of the combination of AFM with WGM sensing is high spatial resolution that is accompanied with enhanced optical sensing capabilities.

Why It Is Better:
WGM resonators are capable of optical imaging without the use of fluorescence probes, thus avoiding complications due to photobleaching of the sample. WGM sensing has not been previously combined with AFM due to difficulties in integrating the resonator and remotely measuring its resonance. Adhering the WGM resonator to a conventional AFM tip and using evanescently scattered light to measure its resonance overcomes these limitations. Additionally, since this approach does not require resonator functionalization, the same resonator tip can be used to quantify binding at several sites. This simplifies calibration and reduces complication arising from Q variation among resonators.

Other Applications:
Any nanotechnology microscopy application.

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