NanoFrazor Technology: Enabling Unique Plasmonic Structures Via Thermal Scanning Probe Lithography

Nicholas Hendricks[1], Jana Chaaban[1], and Emine Çağin[1]

1. Process and Applications Laboratory, Heidelberg Instruments Nano AG, Bändliweg 30, 8048 Zürich, Switzerland

E-mail: nicholas.hendricks@himt.ch

Thermal scanning probe lithography (t-SPL), commercialized under the name of NanoFrazor Technology, is establishing itself as a mature and reliable direct-write nanolithography technique for generating nanoscale structures [1]. As an alternative or complimentary lithography process to standard lithography techniques of electron-beam lithography (EBL) and focused-ion beam (FIB), t-SPL generates patterns by scanning an ultrasharp tip over the sample surface to induce local changes with a thermal stimulus. By using thermal energy as the stimulus, various modifications to the sample via removal, conversion, or addition of/to the sample surface are possible. Along with an ultrasharp tip, with a radius less than 10 nm, the cantilever used in t-SPL contains several other important functions such as an integrated thermal height sensor and an integrated heating element both of which are advantageous for generating 2D and grayscale structures for plasmonic applications.

Applications that are enabled by the NanoFrazor Technology and its capabilities to precisely control temperature include local crystallization of phase change materials for flat-optics [2] and metasurfaces as well as grayscale patterning with sub-nanometer precision for stepped nanoaperatures. For two-dimensional patterning applications, one such example is that of building plasmonic structures from nanomaterials via capillary assisted assembly where assemblies are realized by constructing the guiding template with the NanoFrazor Technology [3,4].

In this presentation, the background and workings of t-SPL will be introduced along with the lithography and processing steps necessary to create plasmonic structures such as plasmonic bow-tie antennas and arrays of plasmonic nanoparticles.

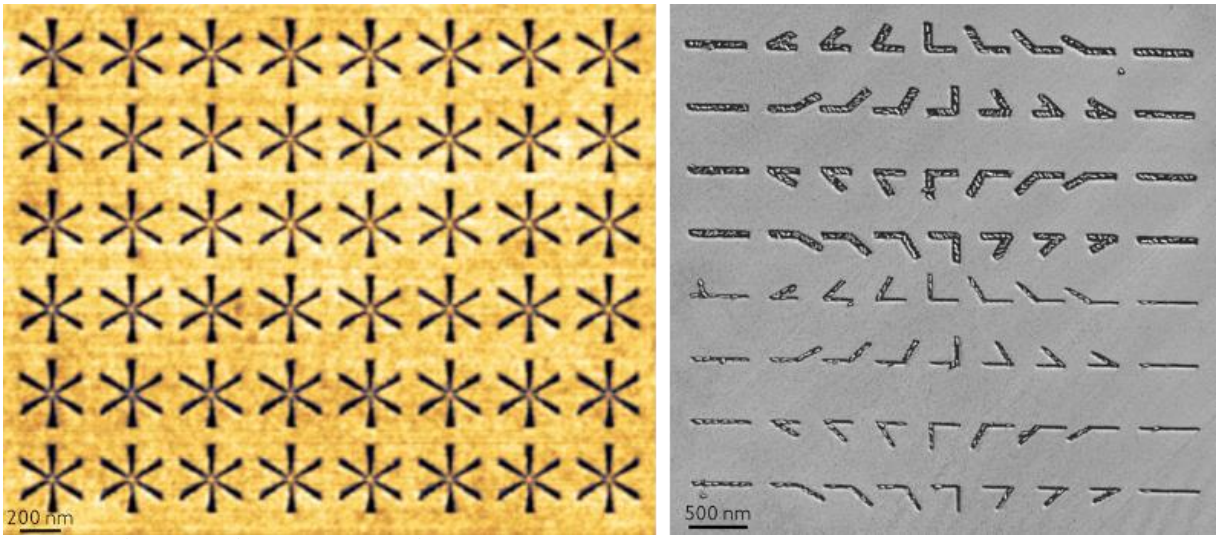

Fig. 1 (left) an array of high-resolution six-fold bow-tie antennas [5]; (right) gold nanorods trapped by grayscale shape matching traps patterned with the NanoFrazor [6].

References

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[5] Internal work between Heidelberg Instruments Nano and Tel Aviv University.
[6] Internal work between Heidelberg Instruments Nano and IBM Research Zurich.