Abstract: A new thermal scanning probe lithography (t-SPL) technology and its applications will be discussed. At the core of the technique is a heated probe tip used for patterning and simultaneous inspection or metrology of complex nanostructures. The heated tip creates high-resolution (<10 nm half-pitch) nanostructures by local decomposition and evaporation of resist materials. The high speed metrology capability enables fast turnaround times of seconds and improved accuracy and reliability. Newly developed stitching and overlay methods allow sub-5 nm accuracy without the use of marker structures. The patterning depth can be controlled with nm accuracy, allowing direct patterning of 3D nanostructures in a single step.

Several pattern transfer options are possible, the example shows transfer onto Si with 3 nm edge roughness and 18 nm half-pitch. High resolution lift-off processes with metals are possible. The use of a heated tip eliminates deposition of electrons or ions onto the sample enabling superior performance for delicate nanoelectronic devices. The patterning of accurate 3D structures allow for nanooptics applications in photonic and plasmonic devices.

This technology has recently entered the lithography market as the first true alternative to electron beam lithography (EBL). In 2014, the first dedicated t-SPL systems, called NanoFrazor, have been installed at universities in Europe and North America by SwissLitho, a spinoff company of ETH Zurich and IBM Research Zurich.