Advanced AFM probes (NeedleProbes™) from NaugaNeedles
(Representing CN Technical Services)

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NaugaNeedles has developed a set of Nanofabrication tools to selectively grow inter-metallic ordered phases of silver-gallium (Ag_2Ga) nanoneedle at any selected location (e.g. atomic force microscope probe). We have found that single Ag_2Ga nanostructures can be induced to grow from silver coated surfaces if contacted with gallium. These nanostructures form readily in melted gallium at room temperature (gallium is supercooled a few degrees below its melting point). A surface, on which the nanowire is going to grow, is sputter coated with silver to a typical thickness of 100 nm. The surface is then brought into contact with and dipped into a gallium droplet at room temperature, and pulled away to make a stable meniscus. The silver layer dissolves, and silver and gallium crystallize within the meniscus, forming a freestanding nanoneedle by pulling the cantilever away from the droplet.

These needles can be fabricated between 1 and 100 µm in length and from 50 to 500 nm in diameter. The orientation of the growth direction can be controlled within a few degrees. We have been able to grow Ag_2Ga nanoneedles on several different types of substrate including AFM probes, Tungsten probes, and Tuning forks.

Figure 1a shows a preferred version of one of these needles on an AFM tip, which is known as one type of *NeedleProbes* ™ product (www.nauganeedles.com) that NaugaNeedles has already introduced to the market.

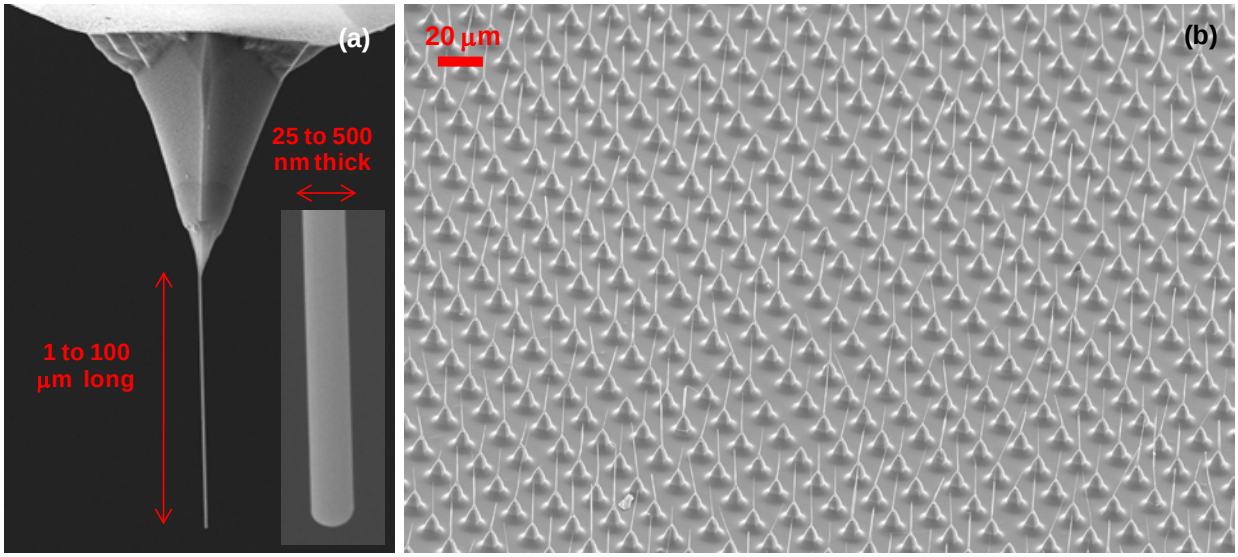

Figure 1. (a) NeedleProbe™. SEM images of a nanoneedle on an AFM tip. Inset shows a close-up view of the end of the NeedleProbe. (b) High yield nanoneedles array grown on AFM-like tips.

Due to several desirable qualities such as their precise and uniform nanoscale dimensions, excellent mechanical and chemical stability, and high electrical conductivity, NeedleProbes are already used for several applications including;

- Imaging high aspect ratio structures
- Electrical characterization including C-AFM, SKPM, EFM, PFM
- Liquid probing
- Nanoindentation on soft or nanopatterned materials
- Tip Enhanced Raman Spectroscopy (TERS)
- Scanning electrochemical Microscopy (SECM) with AFM
- Scanning Tunneling Microscopy (STM)
- Nano Probing inside SEM
- Tuning fork based AFM
- Mass sensing using ultra sensitive NanoCantilevers
- Sample Preparation (Lift-out) for Failure Analysis in semiconductor manufacturing industry.

In addition, NaugaNeedles successfully demonstrated the feasibility of the batch fabrication method for these types of probes. Figure 1b shows an array of these nanoneedles that are self assembled on an array of pillars with AFM-like tips. Arrays with growth yield as high as 90% are fabricated routinely.

In this workshop, NaugaNeedles' CEO will review its technology platform and some of the applications of the NeedleProbes to illustrate how NaugaNeedles products help SPM scientists in advancing their research. NaugaNeedles can also provide extensive modification to the current products and collaborate with SPM scientists to further advance the technology and would like to invite everyone in the community who is interested in collaboration to join this workshop.