Highly Bright and Stable LaB6 Nanowire Electron Source

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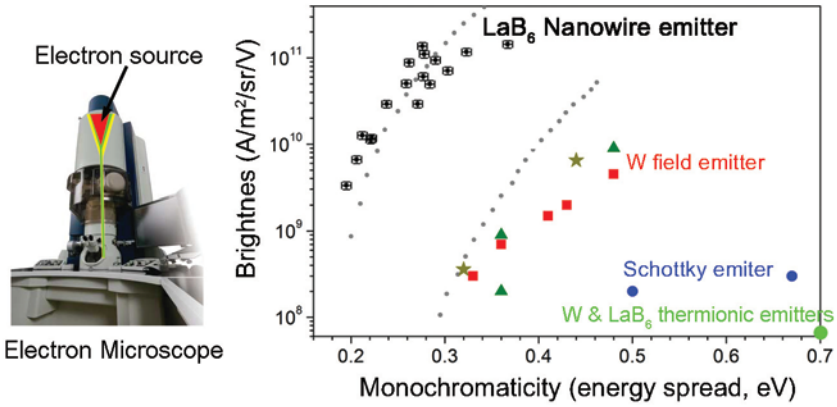
Electron microscopes are powerful and essential tools for nano-scale observation and fabrication that are widely used in both academic research and industry. Cold field emission of electrons is the brightest known form of particle emission. Electron microscopy demands the highest brightness from an electron source in order to exceed the current limits of image resolution. However, emission current instability and stringent high vacuum requirement have made cold field emission gun less favored in the industry though it promises the highest performance. More than 20 years ago, nano-structured electron emitters have been found with much higher brightness and stability compared to the conventional W single crystal needle emitters. Difficulty in structure control over these nano-objects and their poor performance repeatability have hindered further advancement towards real-life microscopy applications. After a brief review over historical efforts, I want to describe a new breakthrough in the field: a LaB_6 nanowire with only a few La atoms bonded on the tip that emits collimated electrons from a single point with high monochromaticity. Installed in a commercial scanning electron microscope, the tip demonstrated: 3000 times current density gain over W (310) tips, no emission decay and noise level as low as 0.1%. The verified life time over 1000 hours and 100 times higher tolerable operating gas pressure have staged the new cold field emitter as the choice for the next generation electron microscopes. [1, 2]



1. Han Zhang, etc. Nature Nanotechnology, 11, 273 (2016);
2. Han Zhang, etc. MRS Bulletin, 42, 511 (2017.)

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