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FABRICATION OF SELF-ORDERED NANO-SCALE EMITTERS IN FEEP

Abstract

Field emission electric propulsion (FEEP) thruster is one of the enabling technologies for a variety of space missions that require ultraprecise attitude and orbit control, such as the measurement of the effects of gravitational waves. The geometry of the emitters in a FEEP thruster is extremely important both for thrust-relevant parameters and for long-term reliability. Generally, better thruster performance will occur when emitter's radius of curvature is smaller. Several manufacturing techniques have been carried out to fabricate emitters out of bulk metal and silicon for miniaturization of the emitters. Unfortunately, it is still a great challenge to develop an emitter with radius of curvature less than 1μm. Here we propose that carbon nanotube can be used as nozzle-type emitters in FEEP to meet the challenge. Well-aligned carbon nanotube arrays are synthesized on self-ordered hexagonal porous anodic aluminum oxide (AAO) template using chemical vapor deposition (CVD) method. The carbon nanotubes obtained are monodispersed and have open tips, which indicates that they have the similar geometry to the present nozzle-type emitters in FEEP. Moreover, the diameter of carbon nanotubes can be controlled by adjusting the pore size of AAO templates. High ordered emitters with small size (radius of curvature) of 50nm can be easily fabricated. The key steps for fabricaiong carbon nanotube emitters are presented.