



**“Enhanced Field Emission from Vertically Oriented Graphene by
Thin Solid Film Coatings”**

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Abstract

The pursuit of field emitter cold cathodes that will replace hot filament electron sources in vacuum microelectronics, especially military equipment, has become a primary national objective. Recent progress and a coordinated national research program have brought considerable effort to bear on the synthesis and application of nanostructures for field emission. Particular emphasis has been given to nanostructured carbon films such as nanotubes, nanohorns, and graphene due to their favorable field emission properties, resistance to environmental assault, and relatively low production cost. At the College of William and Mary, we have developed field emission arrays of vertically oriented graphene (carbon nanosheets) that have demonstrated promising cathode performance, delivering emission current densities up to 2 mA/mm^2 and cathode lifetime >200 hours.

Several recent studies have indicated that enhanced field emission can be achieved by the application of low work function thin films. These studies employ various characterization techniques, such as Auger electron spectroscopy, x-ray photoelectron spectroscopy, time-of-flight secondary ion mass spectrometry, quadrupole mass spectrometry, and Fowler-Nordheim field emission analysis. The impact of thin films ($< 25 \text{ nm}$) of Mo_2C , Cr_2O_3 , and ThO_2 on the magnitude of field emission from carbon nanosheets will be presented. Fundamental studies of thin film growth, morphology, and the effects of thermal treatment will also be discussed with special focus given to the deposition, oxidation, and effectiveness of ThO_2 thin films.