A Coded Aperture Magnetic Sector Mass Spectrometer

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The ultimate goal of this project is to develop a coded aperture microfabricated mass spectrometer (CAMMS) [1]. This instrument concept is based on integrating aperture coding [2], used primarily in optical spectroscopy, with a carbon nanotube-based field emission source, charged particle optics on a microfabricated MEMS (MicroElectroMechanical Systems) platform and a permanent magnet magnetic sector. MEMS technology has been shown to be an excellent platform for the development of miniaturized charged particle devices [3]. However, decreased throughput and small sample sizes in microfabricated instruments are expected to lead to diminished performance. To minimize this degradation in performance we are investigating the principles of multi-aperture coding [1]. Use of coded apertures can eliminate the historical trade-off between resolution and signal intensity in a mass spectrometer. Our current focus is proof of concept work on the application of coded apertures to ion optics in a testbed with a traditional thermal electron ionization ion source. The charged particle simulation program SIMION is utilized to inform system design as well as to establish appropriate working conditions for electrostatic lens systems. This presentation will include: (i) the microfabricated system concept, (ii) the coded aperture-testbed design and optimization, and (iii) results from Hadamard coded apertures that have been shown to provide a 15x increase in throughput as compared to single slits without sacrificing mass resolution.

[1] C.B. Parker, D.J. Brady, J.T. Glass, and M.E. Gehm, Coded mass spectroscopy, US Patent 7,399,957 (2008).

[2] Brady, D.J. and A. Optical Society of, Optical imaging and spectroscopy, 2009, Hoboken, N.J.; [Washington, D.C.]: Wiley ; Optical Society of America

[3] S. Natarajan, C. B. Parker, J. R. Piascik, K. H. Gilchrist, Brian R. Stoner, and Jeffrey T. Glass, “Analysis of 3-panel and 4-panel microscale ionization sources,” J. Appl. Phys., Vol. 107, 124508, June (2010).