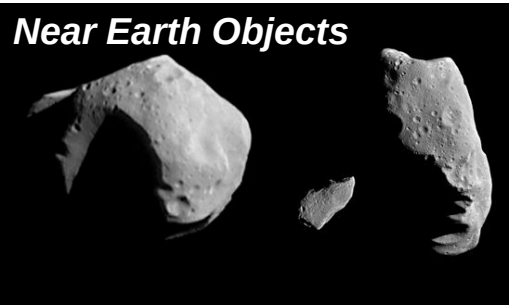
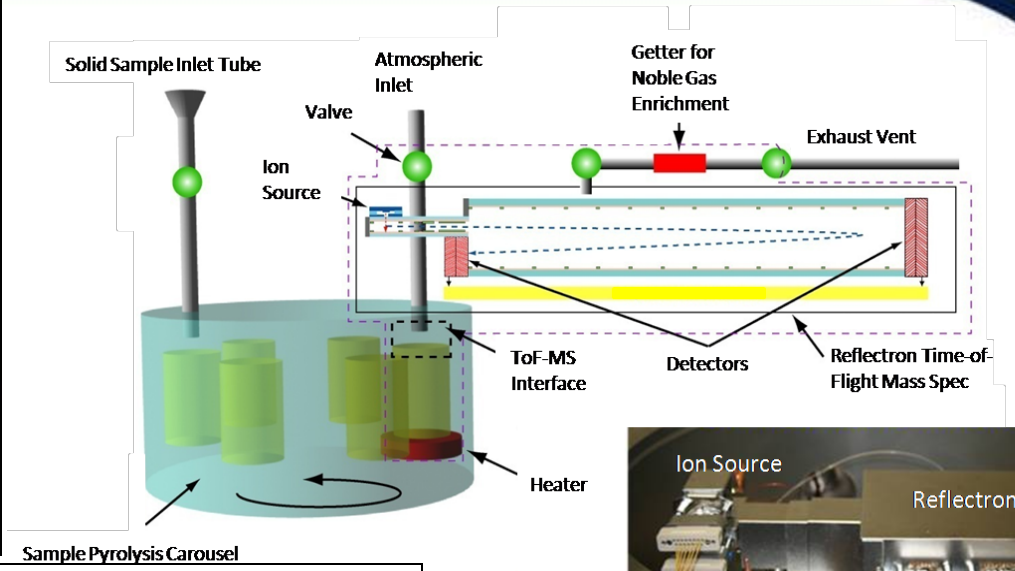
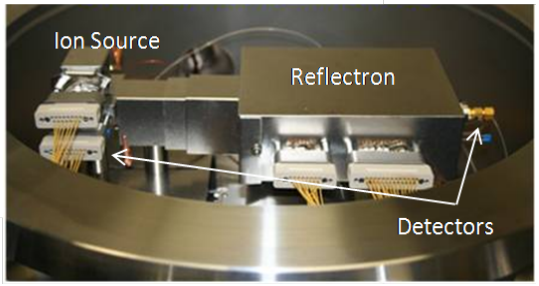
Robust field emission ion source for mass spectrometry analysis of planetary surfaces







Objective:

Develop <u>field emission electron gun</u> for planetary mass spectrometry

- Low power
- Compact footprint
- High sensitivity
- Long lifetime

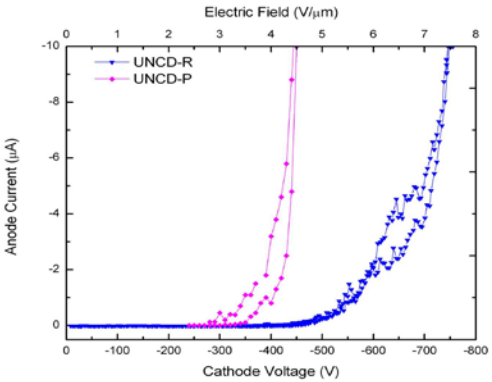
VAPoR

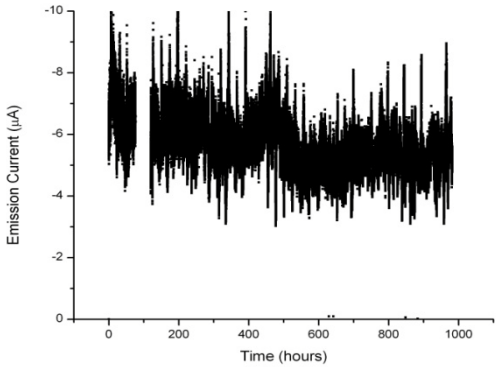
Volatile Analysis by Pyrolysis of Regolith

PI: D. Glavin

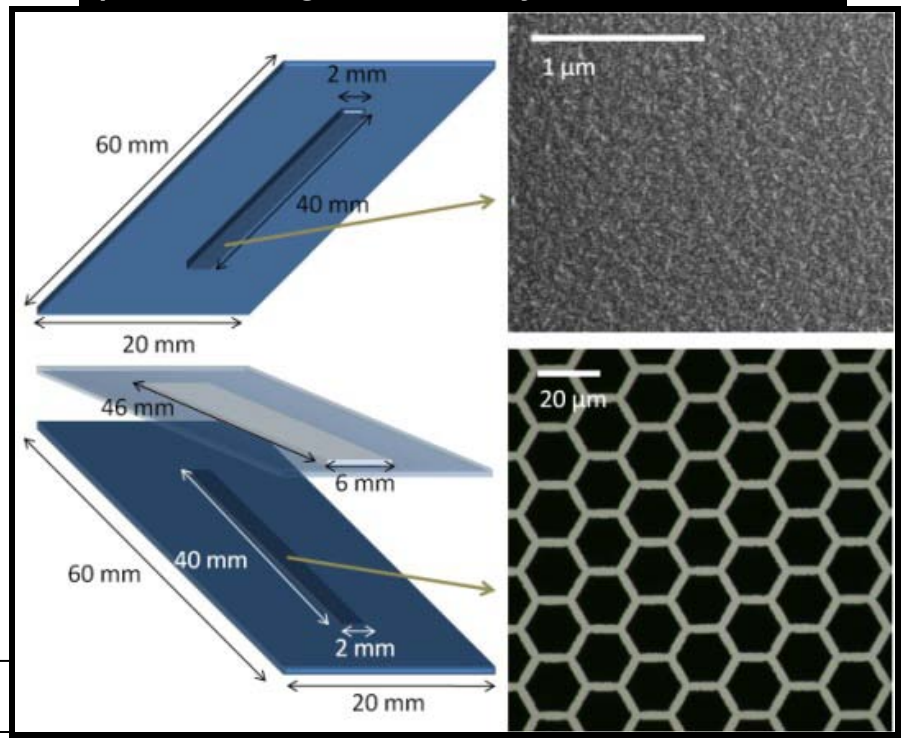
Scaling Up Field Emission Architecture

New Material: Nitrogen-incorporated Ultrananocrystalline Diamond (N-UNCD)
Low-electric field operation (turn on at 2-5 V/µm) + Long lifetime (>1000 hours)

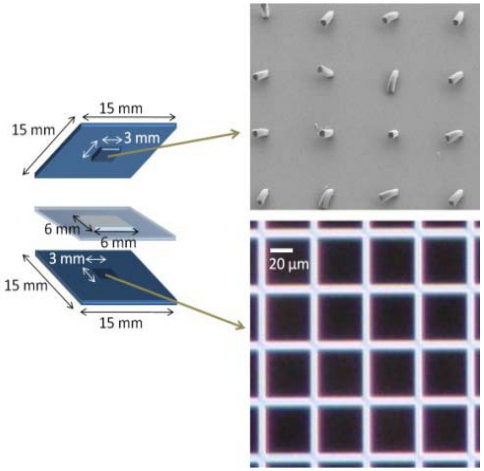




Combine field emission properties of N-UNCD with scaled-up architecture to produce high-sensitivity ion source



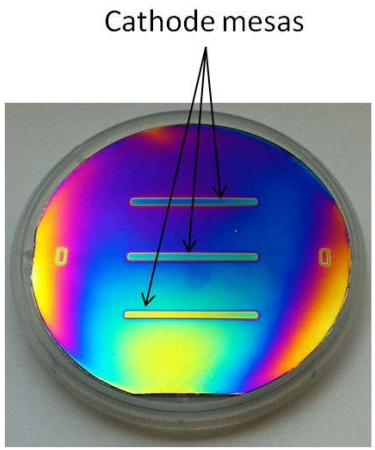
Previous design:
Small-footprint electron gun architecture demonstrated with carbon nanotubes
- Cathode
- Insulating spacer
- Perforated grid

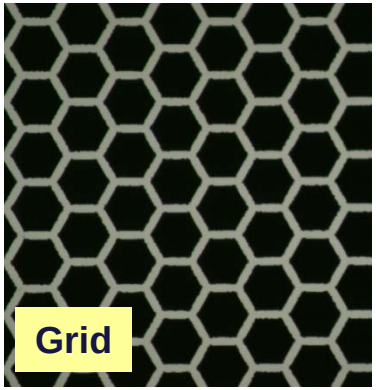


Obtained VAPoR mass spectrum with <u>low sensitivity</u>

Status and Next Steps

<u>Pending work</u>: Assembly of grid/insulator/cathode stack • Assembly of extended ion source with electrostatic lenses • Integration with VAPoR ToF-MS



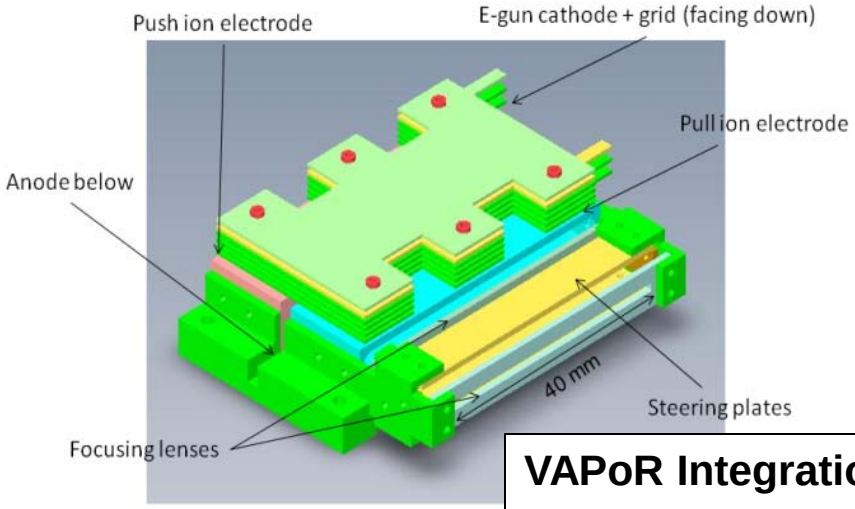


Fabrication complete:
<u>Cathode</u> wafers (3) patterned and coated with N-UNCD

<u>Spacer</u> wafers (3) patterned and machined

<u>Grid</u> wafers (2) patterned and etched

<u>Integration</u> in process; grid wafer bonded to spacer, pending indium bump bonding to cathode



VAPoR Integration:

<u>Extended ion source</u> assembly underway
- Electrical contact to cathode and grid
- Electron beam focusing lenses
- Ion accelerating, focusing, and steering lenses