



Deposition Measurements with a Quartz Crystal Oscillator

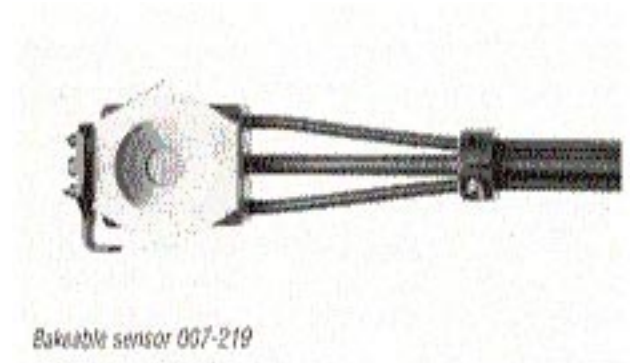
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NSTX Research Forum

September 11-13th
Princeton Plasma Physics Laboratory
Princeton, NJ

Motivation:

- Boronization is key to achieving good plasma conditions
 - we need to monitor this directly.
- Deposition monitors utilize the change in frequency of a quartz crystal oscillator as material is deposited on the surface, and have a \approx angstrom resolution. They have been successfully used on the TdeV tokamak [D Bourgoïn et al., J. Nucl. Mater. 241-243 (1997) 765] and more recently by Ruzic's group to monitor sputter cleaning, and by Rohde in Asdex divertor & pump duct to measure deposition of radicals with high sticking probability [PSI-15].



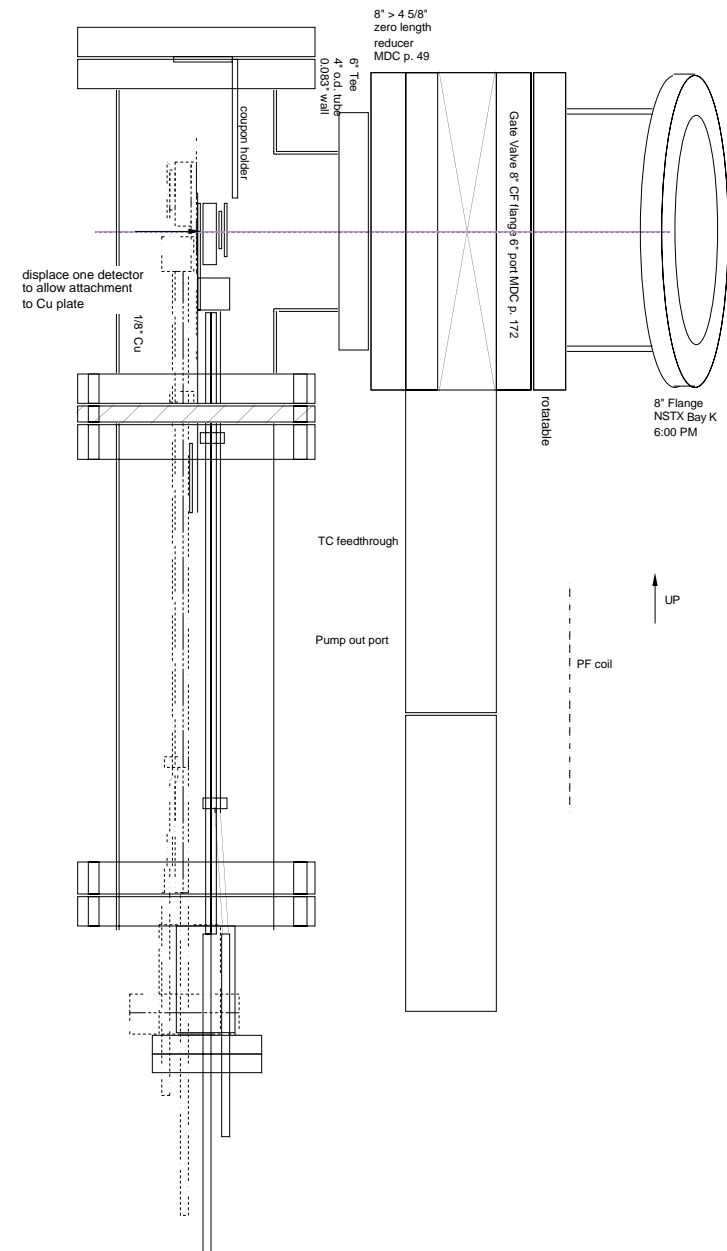
UHV Bakeable Sensor

Ideal for UHV applications, bakeable to 450 °C. The assembly is available in three standard lengths and includes sensor and ConFlat[®] feedthrough. Also available with an optional shutter assembly.

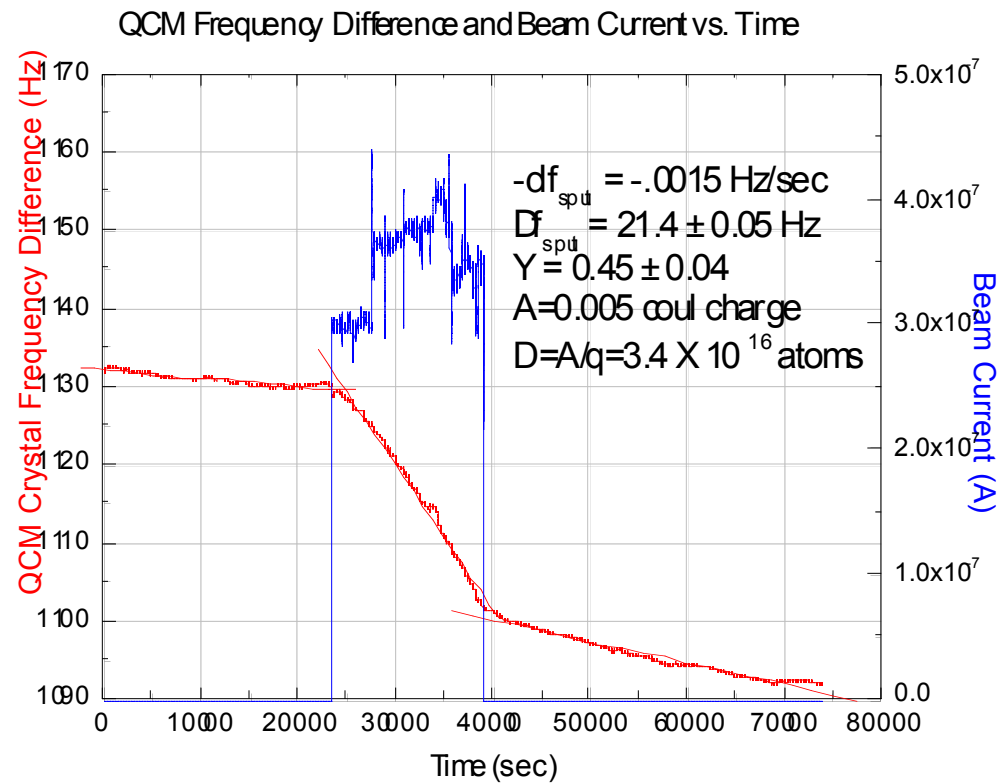
Sensor Specification:

- Resolution 1 Å (\approx one monolayer)
- Accuracy 0.5%
- Bakeable to 450°C - water cooled during deposition monitoring.
- Built in shutter on plasma facing detector.
- The crystal lifetime depends on the material deposited, typically after 3 microns of MgF or 15 microns of Cu there is no longer a resonance and the crystal needs to be changed (a package of 10 crystals is \$64).
- The thermal equilibration time of the sensor is of order 30 s enabling readout to occur in between discharges (cannot measure during discharge).
- Oscillation frequency changes both with temperature and deposition. Plasma facing sensor experiences deposition and temperature drift, rear facing sensor experiences only temperature drift. Difference frequency corresponds to deposition.
- Digitize oscillation frequency and temperature at 10 Hz (lowest frequency available).

- Propose to install back-to-back sensors behind 8" gate valve at Bay K. Back facing monitor responds only to temperature change. Difference frequency measures deposition.
- Digitize oscillation frequency and temperature at 10 Hz.
- Monitor can be removed for maintenance & crystal replacement.
- Send used crystals for analysis at Evans East and Sandia Lab (Wampler collaboration)
- Si witness coupon placed alongside.
- Based on experience, install monitor inside vessel at later stage.



Sample data from Ruzic lab experiment:



Planned Measurements:

- Thickness of boron film from boronization [10g TMB -> 96 nm layer]
- Intershot measurement of TMB plasma boronization (depending on flux).
- Measure potential window deposition during plasma boronization or CHI before opening diagnostic shutters.
- Deposition during disruption ?
- Deposition after pellets ?
- Long term measure of charge exchange neutral erosion of boron film
- Correlation with long term sample coupons
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