



# Deposition Measurements with a Quartz Crystal Oscillator

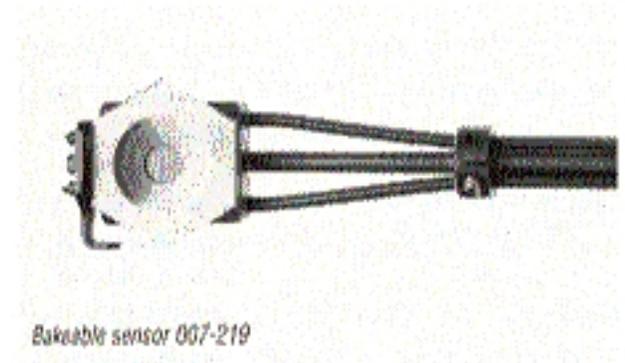
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NSTX Research Forum

November 28-30th, 2001  
Princeton Plasma Physics Laboratory  
Princeton, NJ

## Motivation:

- Boronization is key to achieving good plasma conditions
  - we need to monitor this directly.
- We have such a system in house
- Deposition monitors utilize the change in frequency of a quartz crystal oscillator as material is deposited on the surface, and have a sub 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 in Illinois, and by Rohde in Asdex.
- Two sensors typically used to one exposed to the deposition, the other shuttered and used as a reference to compensate for the temperature dependence of the oscillation frequency.



### UHV Bakeable Sensor

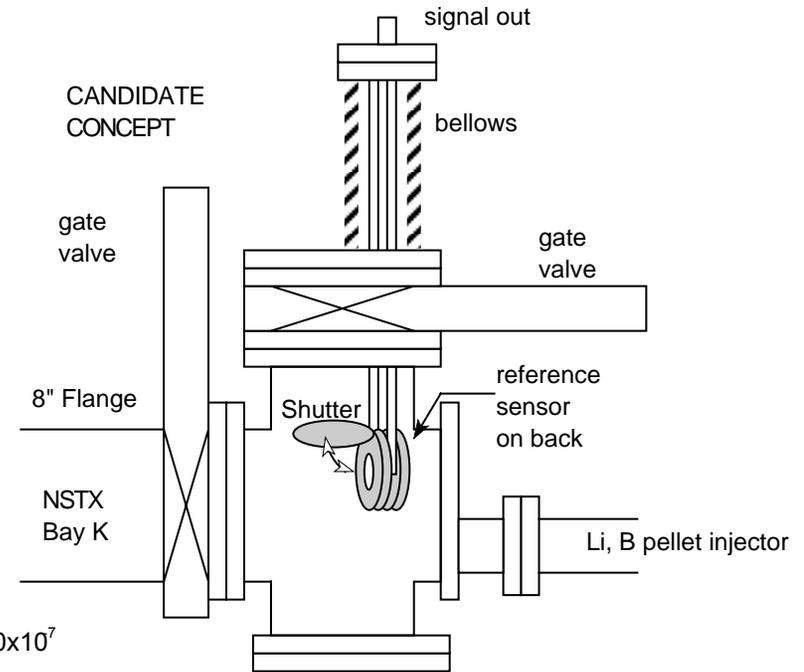
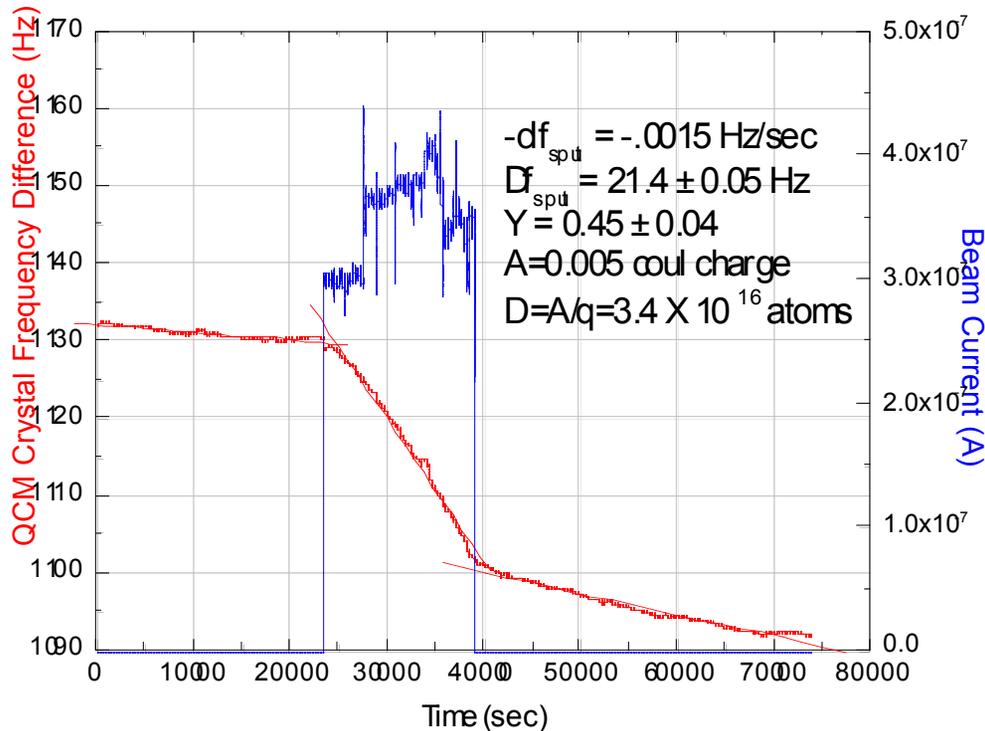
Ideal for UHV applications, bakeable to 450 °C. The assembly is available in three standard lengths and includes sensor and ConFlat<sup>®</sup> feedthrough. Also available with an optional shutter assembly.

Plan to install back to back sensors at 8" gate valve at Bay K (near NPA)

Use a vacuum cross with retractable feedthrough to enable monitor to be removed for maintenance.

### Sample data from Ruzic

QCM Frequency Difference and Beam Current vs. Time



## Sensor Features:

- The sensor has an all welded construction, the signal cable is co-axial with a solid tube. The sensor has a 2.75 conflat vacuum interface.
- It is water cooled during deposition monitoring with flexible tubes so the orientation of the sensor is adjustable. The length of the coax tube and water tube is 19.81”.
- A BNC socket + 6” cable connects sensor to the oscillator to the oscillator package. The Controllers can be 15’ to 100’ distant and are controlled and read out via a RS232 connection (IEEE488 is also available).
- The shutter is normally closed and pneumatically operated.
- 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.

Deliverables:

- thickness of boron film from boronization and plasma boronization
- direct measure of charge exchange neutral erosion of film vs. shot
- correlation with long term sample coupons