

A comparative study of secondary ion emission from water ice under ion bombardment by Au^+ , Au_3^+ and C_{60}^+

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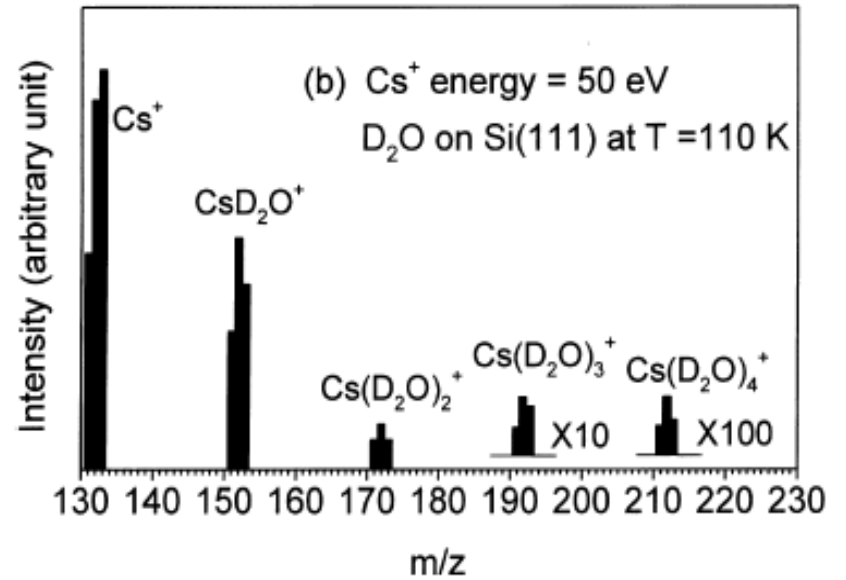
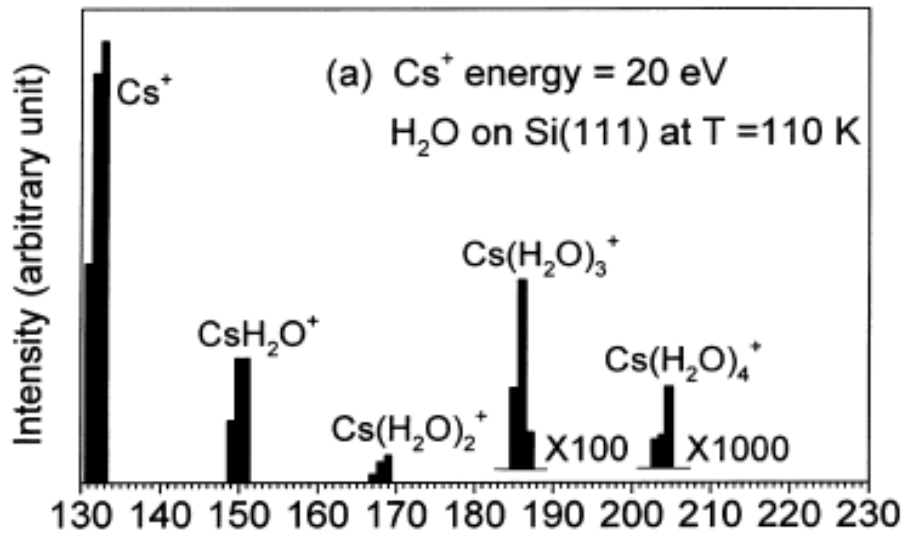
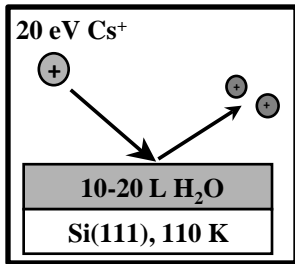
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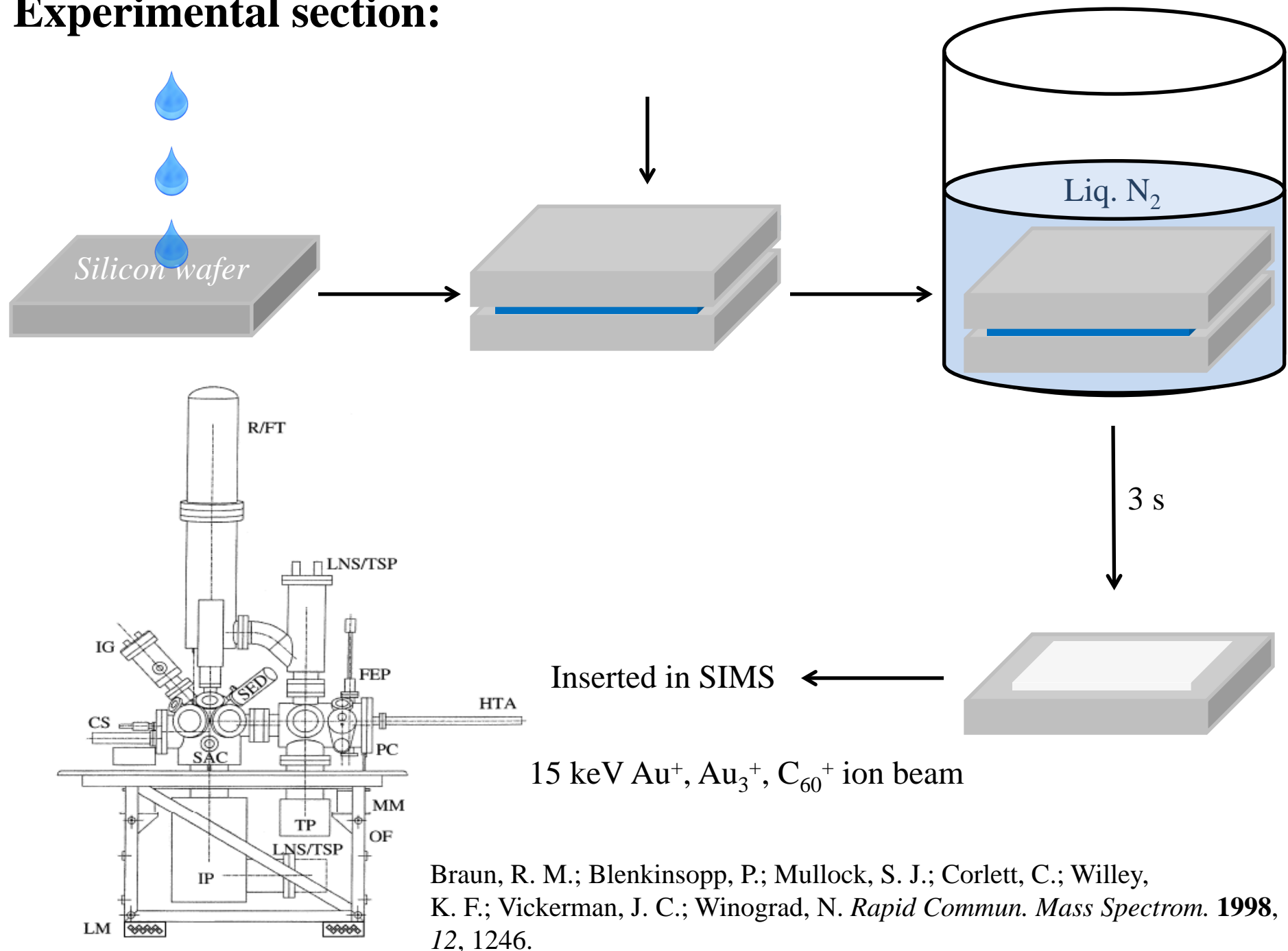
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Introduction:

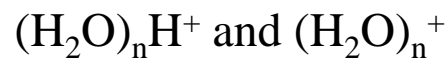
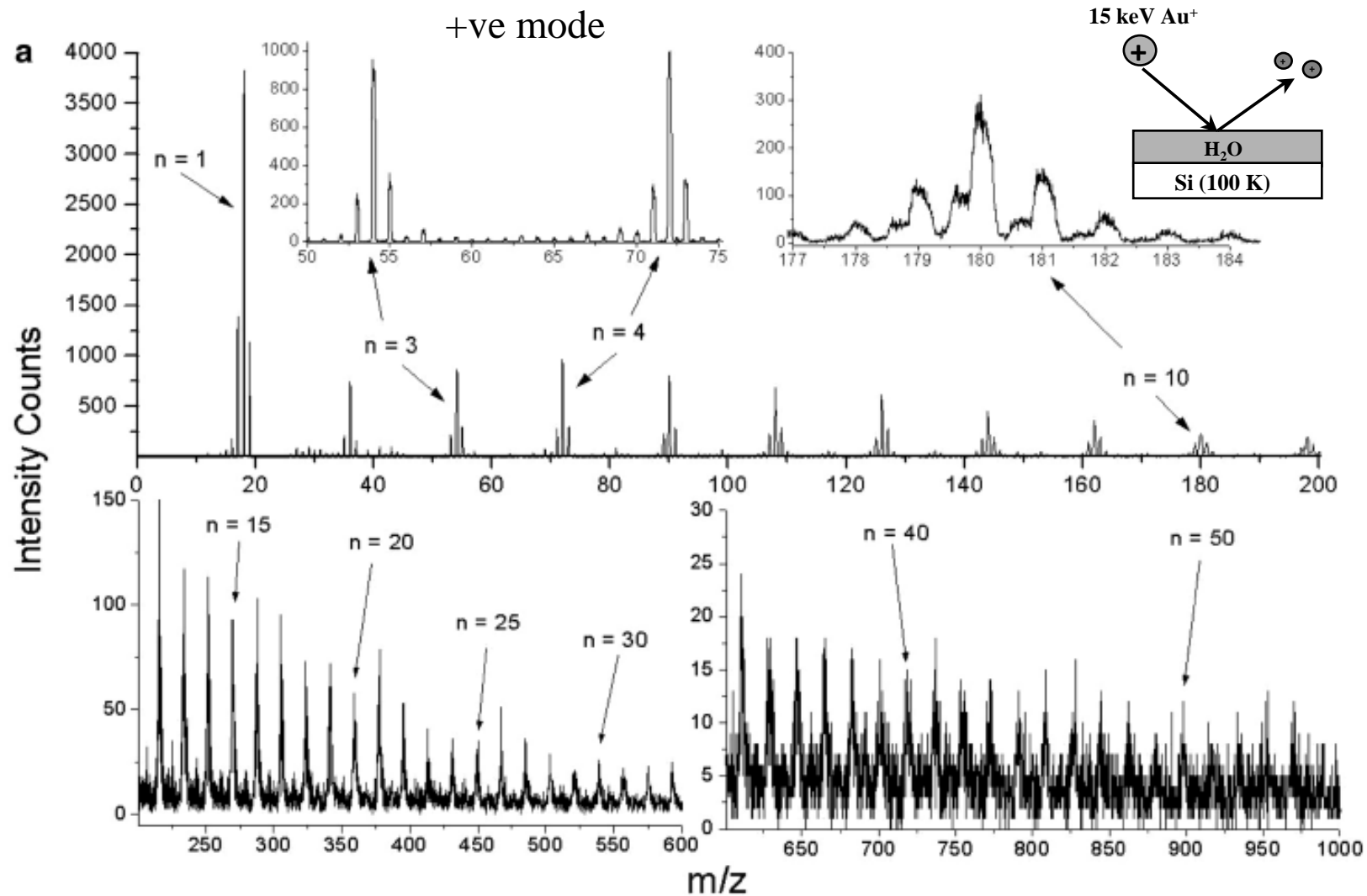
- SIMS spectra from ice consist of an extensive series of water cluster ions.
- Recently it has been shown that quite extensive cluster formation occurs within water itself.
- All the solid phases of ice involve the water molecules being hydrogen bonded to 4 neighbouring water molecules.
- The surface consists of a quasi-liquid bilayer with surface species that have one of three structures, a four-coordinate water and three-coordinate waters with either hydrogen or oxygen dangling bonds.
- Protonated cluster stability, $\text{H}_3\text{O}^+ > \text{H}_5\text{O}_2^+ > \text{H}_7\text{O}_3^+ > \text{H}_9\text{O}_4^+$
- $\text{H}_7\text{O}_4^- > \text{H}_3\text{O}_2^-$
- Among the protonated water cluster $\{(\text{H}_2\text{O})_{n-1}\text{H}^+\}$, $n=4$ & 21 were found to be more stable than its neighbor.
- Water cluster size is linear upto $n=3$, star shape at $n=4$, subsequently cyclic structures take over.
- $\text{OH}^-(\text{H}_2\text{O})_n$ are observed in SIMS studies.
- $(\text{H}_2\text{O})_n^+$ is not observed in gas phase studies, nevertheless it can be observed in gas phase if there is any third body present in molecular beam.

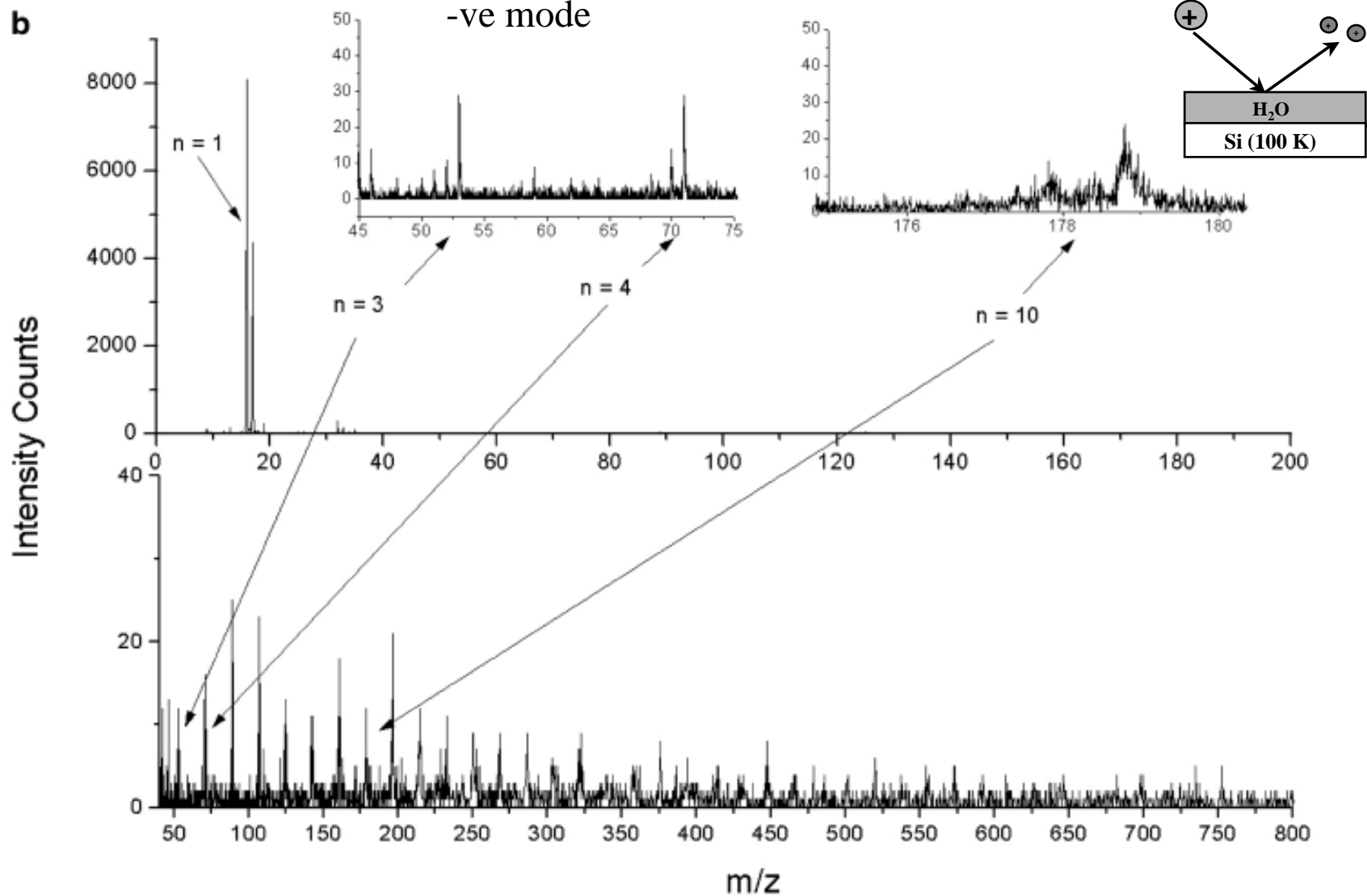


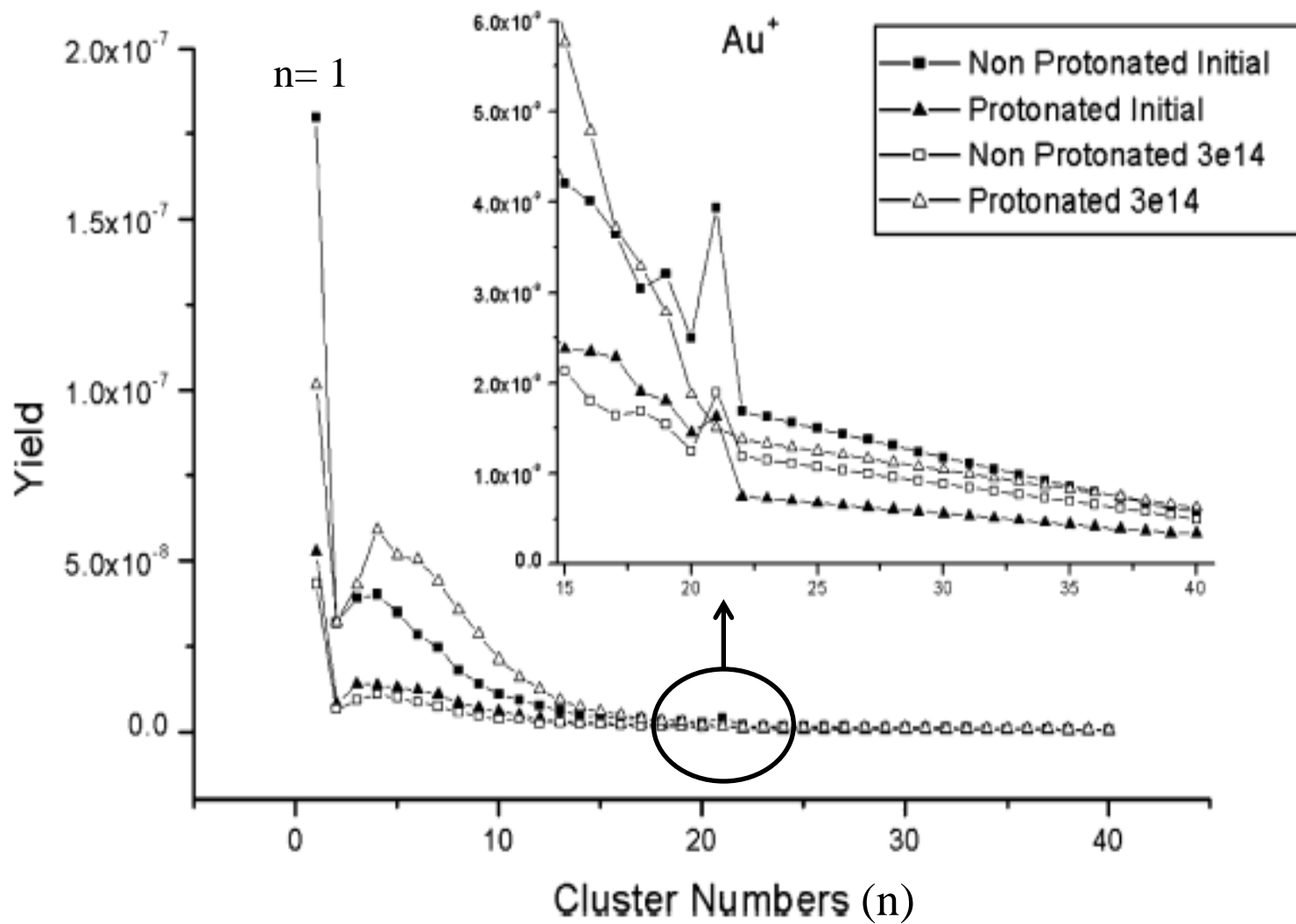
Experimental section:

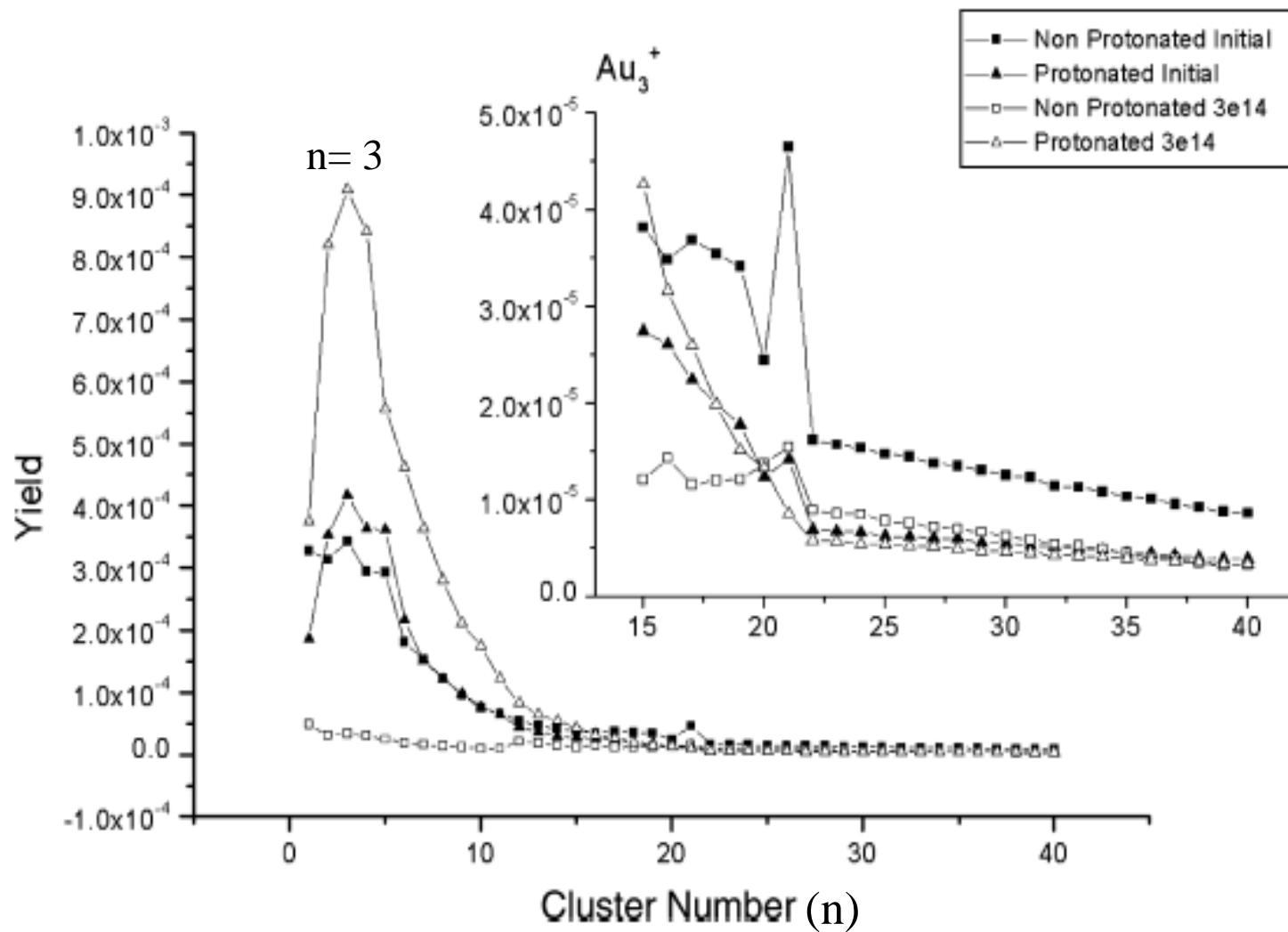


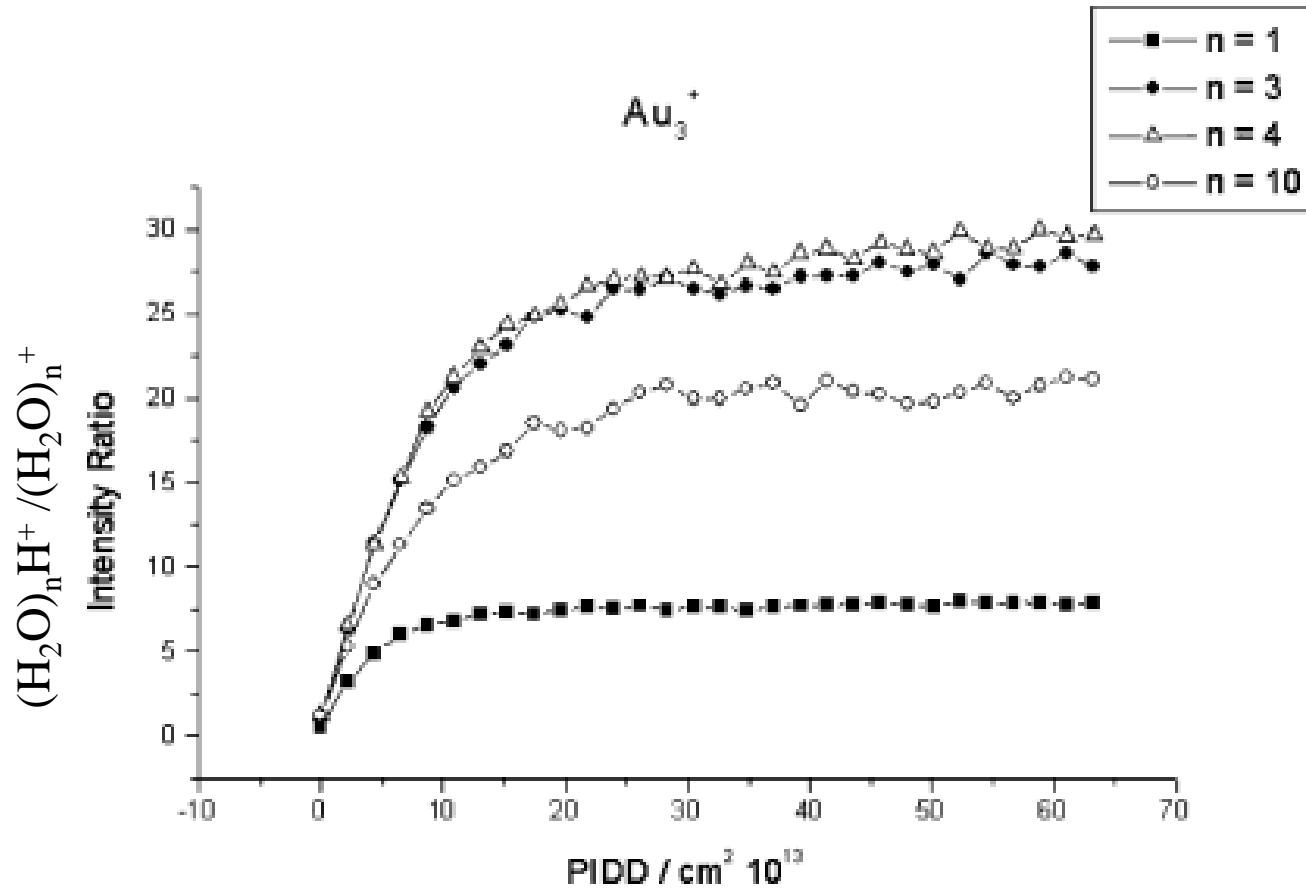
Results:



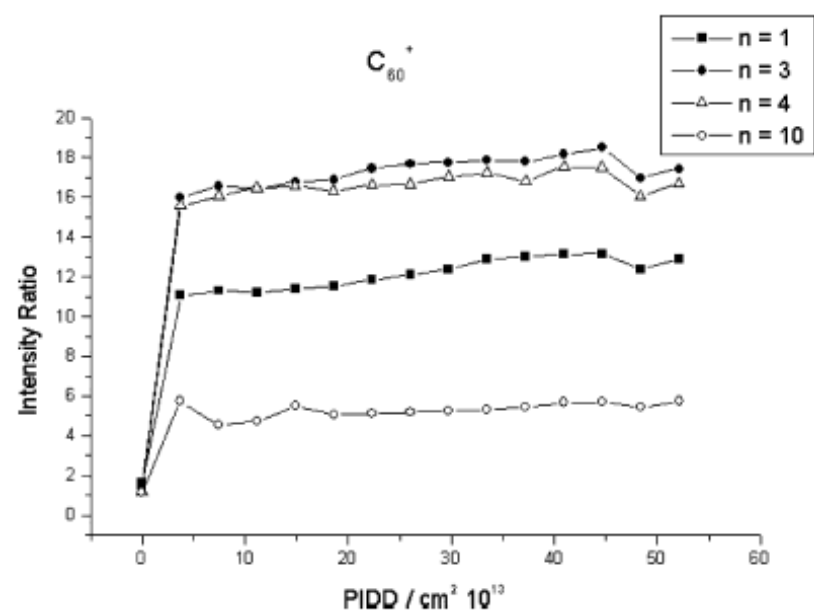
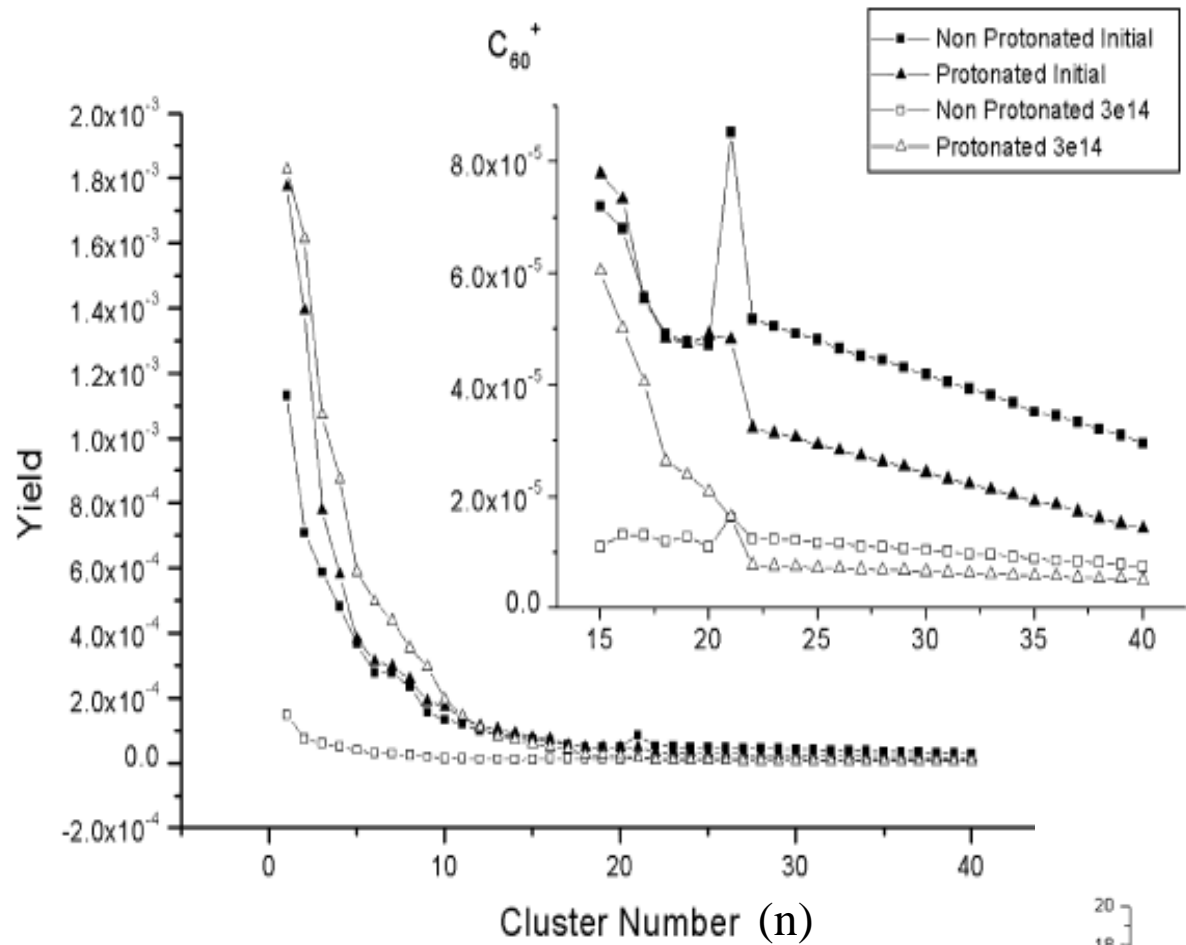




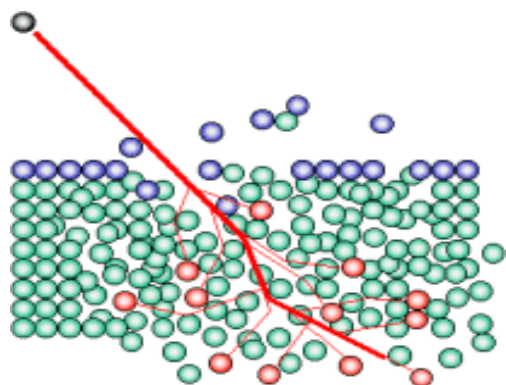




PIDD= Primary ion dose density

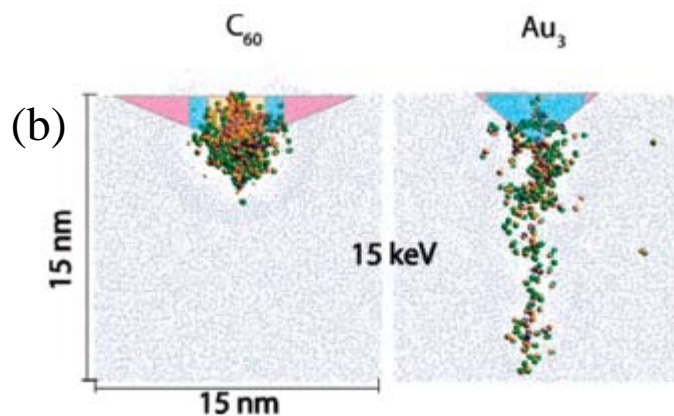
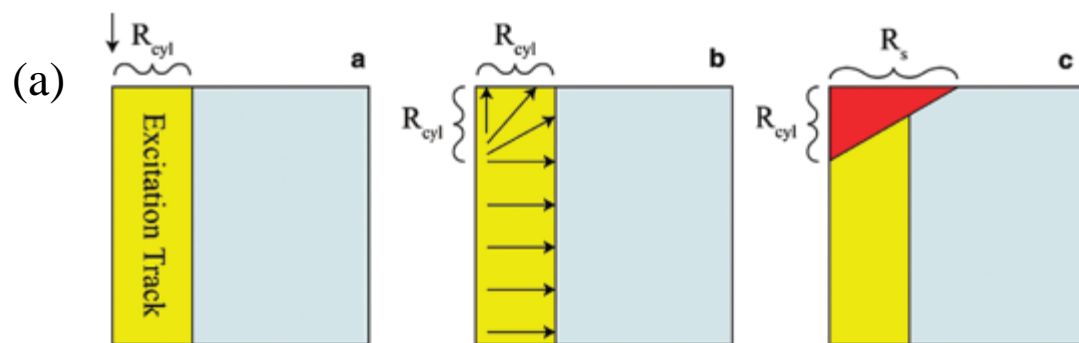


Monoatomic



Schematic of the collision cascade

Polyatomic



(a) Russo, M. F., Jr.; Garrison, B. J. *Anal. Chem.*, **2006**, 78, 7206 (b) Ryan, K. E.; Wojciechowski, I. A.; Garrison, B. J., *J. Phys. Chem. C*, **2007**, 111, 12822.

Summary:

- Ion formation as a consequence of sputtering water ice is different from ion formation in the gas phase.
- Yield of Au^+ is lower than that of Au_3^+ and C_{60}^+ sputtering.
- The high yield is understood using different model than conventional.
- Increasing dose will suppress the $(\text{H}_2\text{O})_n^+$ and higher cluster yield significantly.
- Negative ion spectra are observed for the first time with cluster.

Last slide:

- Writing of scientific paper should be concise and to the point.
- Monoatomic and polyatomic collision cascades are different and it is greatly influenced by molecular weight.
- For different type of projectiles (H^+ & D^+ to CH_3^+ & CH_2^+), yield is different and product nature after subsequent sputtering may be different also.

Thank you