Gas Analysis
Application Note 237

Process Gas Analysers

HPR-30 Series for Process Characterisation

Summary

In order to fully characterise a plasma process it is important firstly to identify each of the critical processing steps. These may include high vacuum preparation, backfill with reagent gases, processing step and finally post processing pump down. In each of these stages Hiden's HPR-30 Series provides the diagnostic and data handling capability to ensure key information is routinely measured, logged and interrogated. The measurements described in this note were carried out using an HPR-30 Series instrument to monitor the various processing steps during a wafer device etching stage.

Manufactured in England by:

HIDEN ANALYTICAL LTD
420 Europa Boulevard, Warrington, WA5 7UN, England
t: +44 (0) 1925 445225 f: +44 (0) 1925 416518
e: info@hiden.co.uk w: www.HidenAnalytical.com

Step 1: Base Pressure Residual Gas Analysis

With the process tool under vacuum a fingerprint of the residual gases using the integral “RGA” facility is obtained. This will reveal the composition of base pressure components such as hydrogen, water and nitrogen. These initial measurements will indicate whether there are any issues to be addressed, such as locating the source of an air leak or if a bakeout cycle on the chamber is required, the residual gas composition can have a significant impact on the process plasma composition and therefore the gases should be identified and compared from run to run. In addition, the integrity of for instance, gas feed lines can be checked by taking a series of RGA fingerprints with different parts of the tool isolated from the mass spectrometer.

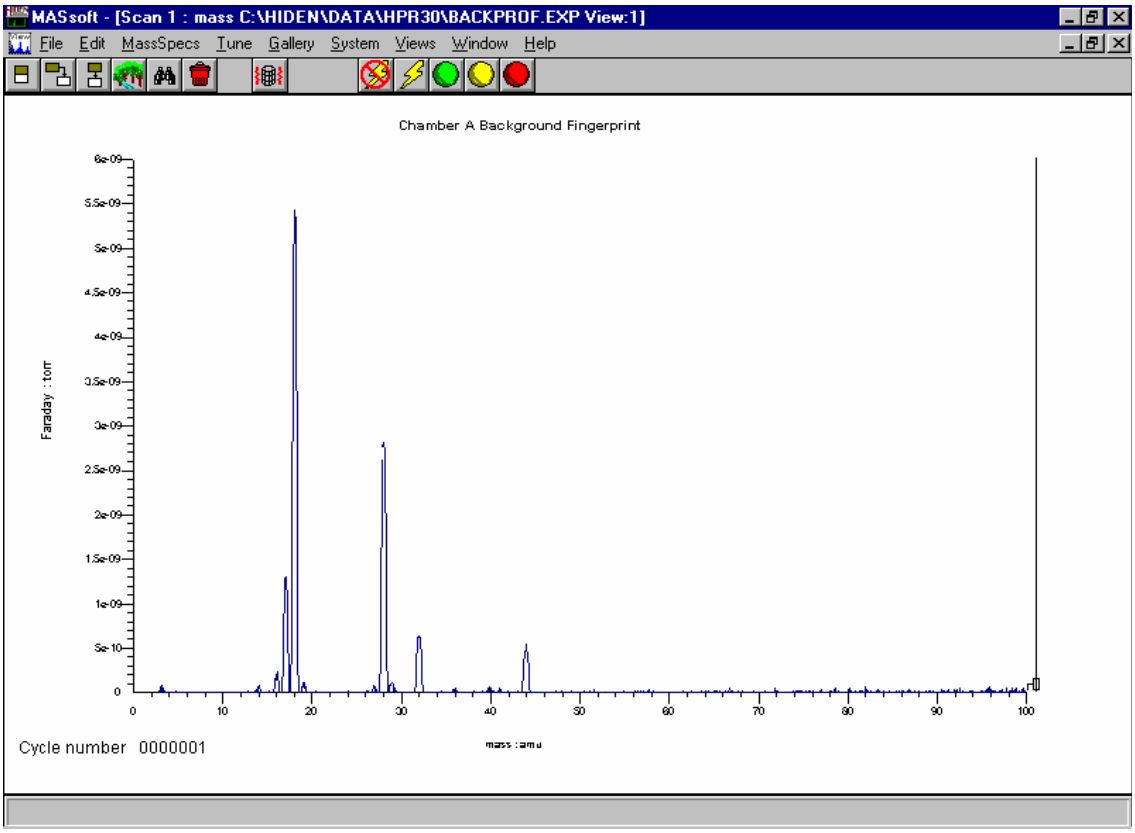
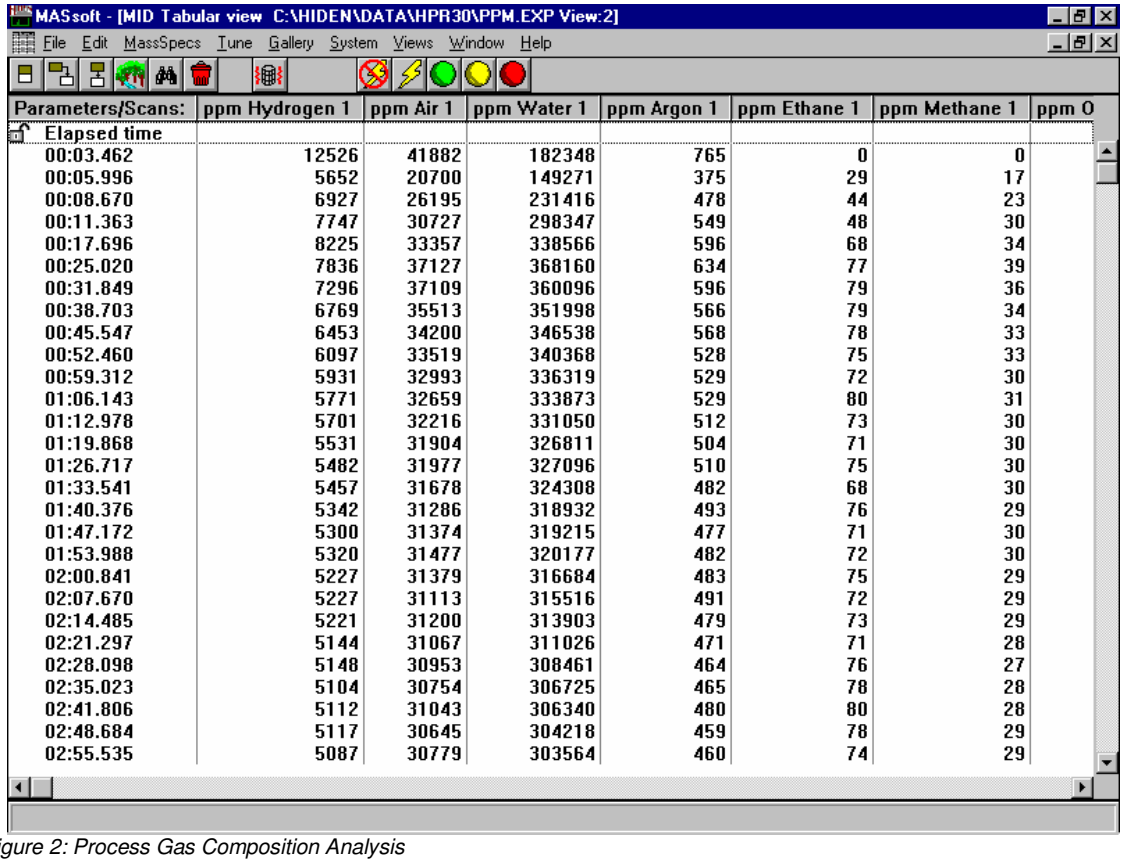


Figure 1: Base Pressure Residual Gas Analysis

Step 2: Process Gas Composition Analysis

Following base pressure analysis the process chamber is back filled with reagent gases (for example nitrogen, chlorine or hydrogen bromide). Using the “gas analysis” feature, the HPR-30 will confirm the process gas composition and detail the levels of any contaminants and residuals. The combination of base pressure residuals (still present during the processing step) and contaminant gases, from the process gas lines and associated inlet system, contribute to the quality of the process. All of these components can be automatically saved in template form for future runs and comparisons between batches.



Parameters/Scans:	ppm Hydrogen 1	ppm Air 1	ppm Water 1	ppm Argon 1	ppm Ethane 1	ppm Methane 1	ppm O
Elapsed time							
00:03.462	12526	41882	182348	765	0	0	
00:05.996	5652	20700	149271	375	29	17	
00:08.670	6927	26195	231416	478	44	23	
00:11.363	7747	30727	298347	549	48	30	
00:17.696	8225	33357	338566	596	68	34	
00:25.020	7836	37127	368160	634	77	39	
00:31.849	7296	37109	360096	596	79	36	
00:38.703	6769	35513	351998	566	79	34	
00:45.547	6453	34200	346538	568	78	33	
00:52.460	6097	33519	340368	528	75	33	
00:59.312	5931	32993	336319	529	72	30	
01:06.143	5771	32659	333873	529	80	31	
01:12.978	5701	32216	331050	512	73	30	
01:19.868	5531	31904	326811	504	71	30	
01:26.717	5482	31977	327096	510	75	30	
01:33.541	5457	31678	324308	482	68	30	
01:40.376	5342	31286	318932	493	76	29	
01:47.172	5300	31374	319215	477	71	30	
01:53.988	5320	31477	320177	482	72	30	
02:00.841	5227	31379	316684	483	75	29	
02:07.670	5227	31113	315516	491	72	29	
02:14.485	5221	31200	313903	479	73	29	
02:21.297	5144	31067	311026	471	71	28	
02:28.098	5148	30953	308461	464	76	27	
02:35.023	5104	30754	306725	465	78	28	
02:41.806	5112	31043	306340	480	80	28	
02:48.684	5117	30645	304218	459	78	29	
02:55.535	5087	30779	303564	460	74	29	

Figure 2: Process Gas Composition Analysis

Step 3: Plasma Process Fingerprint

With the chamber at the correct processing pressure the plasma is powered on. The gas analysis feature (as detailed in **Step 2**) can be used to review and record the neutral gas composition of the plasma. The spectra produced then provide a basic fingerprint of the process. These spectra can be compared from batch to batch, and chamber to chamber in order to establish reproducibility and transferability. The data represents a quality control report for each process run.

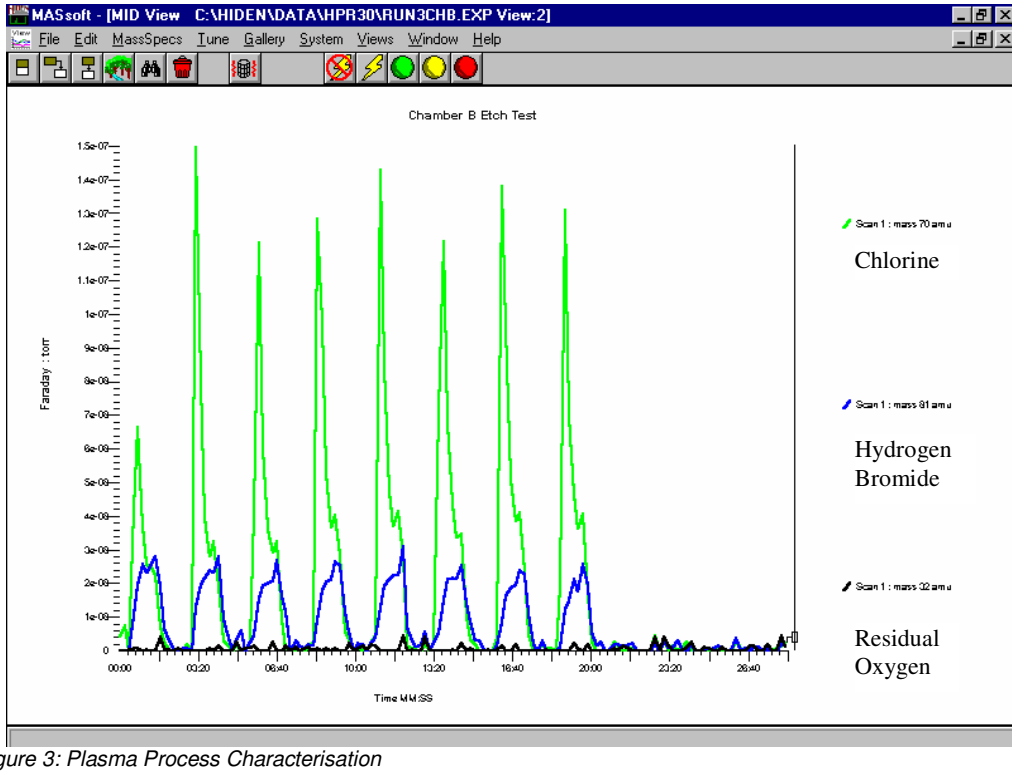


Figure 3: Plasma Process Characterisation