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PECVD CAPABILITY

Plasma enhanced chemical vapour deposition (PECVD) chamber

Overview

Plasma enhanced chemical vapour deposition (PECVD) and Inductivity coupled plasma - plasma enhanced chemical vapour deposition (ICP PECVD) are techniques that can be used to deposit a variety materials through creating a mix of reactive radicals and ions from gaseous precursors, which react on the surface of the substrate to form a thin film.

The gases are injected as a mixture towards the substrate electrode where power is applied or through an ICP tube and SiH4 injected through an injection ring. This allows for minimal particle formation and maximum reactivity on the surface of the substrate.

With ICP PECVD, the use of ICP can reduce or eliminate the use of radio frequency (RF), which can be detrimental to film quality and substrate interface quality. This can also lead to deposition temperatures used being much lower while still maintaining a good crystal quality.

In the PECVD, the use of both high and low frequency RF on this electrode a variety of different stresses within the film can be controlled during deposition. With an electrode which can be used at high temperatures, lower plasma powers are needed, with thermal equilibrium on the surface aiding in the creating good crystal quality.

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With a variety of materials available on both for deposition, multilayer films can be grown. With a low base pressure(high vacuum), annealing and plasma treatments can be carried out in-situ allowing for a variety of pre and post deposition processes to occur all in one deposition chamber.

Capability profile
System: Oxford Plasma Technologies PlasmalabSystem100 ICP180 and PlasmaPro100 Strartum

The depositions we focus on in this system are Si based materials. With a variety of precursors and materials available we can create multilayers without breaking vacuum, as well as variety of pre deposition plasma or annealing treatments in an ultra-high vacuum environment.

With end point detection, the chamber is kept to a high standard with minimal particle contamination for all films grown. With low deposition temperatures, typically 100°C for ICP PECVD depositions, samples with materials of low thermal stability can be deposited on with little deterioration of existing layers.

With the use of ICP, the use of RF can be drastically reduced meaning materials can be grown whilst retaining the quality of the existing materials, with limited damage at the interface compared to other deposition techniques.

With control of LF/HF ratios during growth we are able to directly control the stress of subsequent films to a high degree without overall changing the compositions of the film itself. Such layers can then subsequently be used for a variety of applications ranging from CMOS compatible hard masking, gating of delicate devices to suspended membranes and solar cell passivation.

The high purity and crystallinity of the materials deposited allows for high selectivity to etching both wet and dry. This PECVD is used throughout the 2DM device fabrication process from initial substrate preparation through to latter stages of encapsulating final films of a device.

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Gases available	NH_3, Ar, H_2, CH_4, N_2, N_2O, O_2, SiH_4, CF_4
Table temperature	PECVD: from RT to 700°C with standard depositions at 400°C ICP PECVD: from RT to 400°C with standard depositions at 100°C
Current depositions supported	PECVD: SiN ICP PECVD: SiN, SiO, a-Si, SiON

Sample size from fragments of wafer to 6” wafers

Inductivity coupled plasma power max 3000W (ICP PECVD)

Low frequency and high frequency RF plasma- alternating or mixed (PECVD)

RF power max	PECVD: 300W ICP PECVD: 600W

LF RF max 300W (PECVD)

Pressure max	PECVD: 5000mTorr ICP PECVD: 100mTorr
Base pressure	PECVD: 1 mTorr ICP PECVD: 2×10^{-7}

4” coverage ± 2nm

Low pressure strike capabilities (ICP PECVD)

Automated sample loading and unloading through load lock

Capture of all parameters up to every 1 second

He backing for sample for best thermal contact in vacuum environment up to 300°C