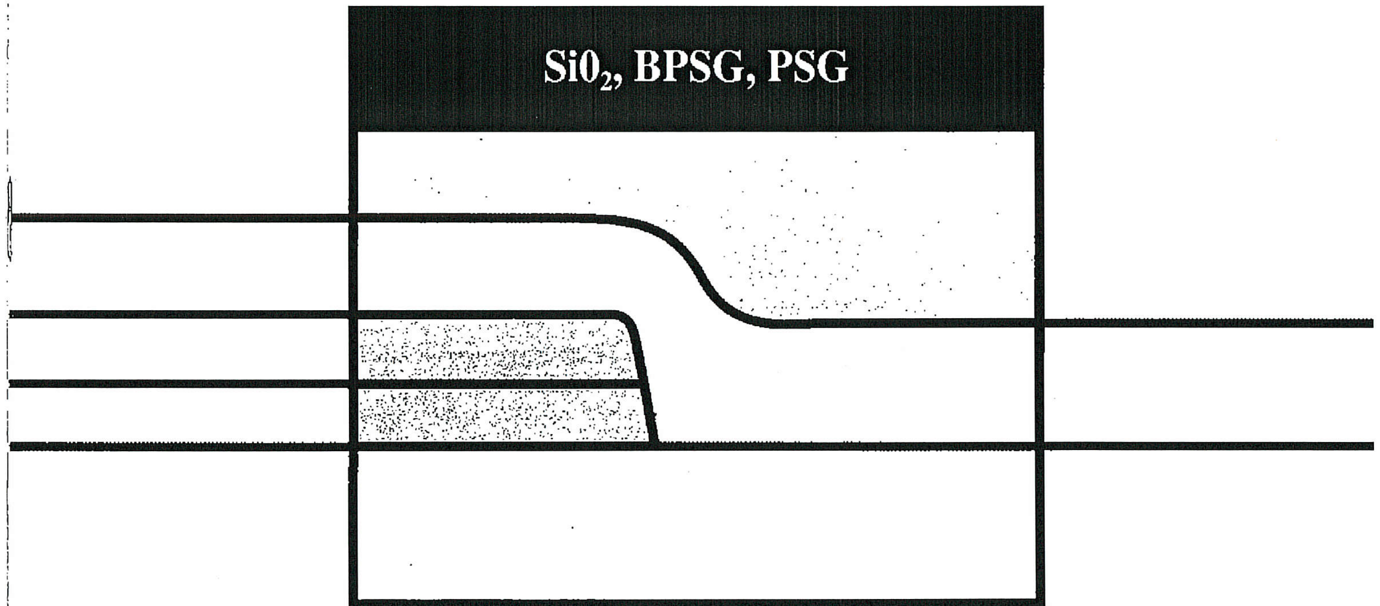
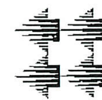


CONCEPT ONE

CVD SYSTEM

PROCESS SPECIFICATIONS



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SiO_2, BPSG, PSG

◆ **INTRODUCTION**

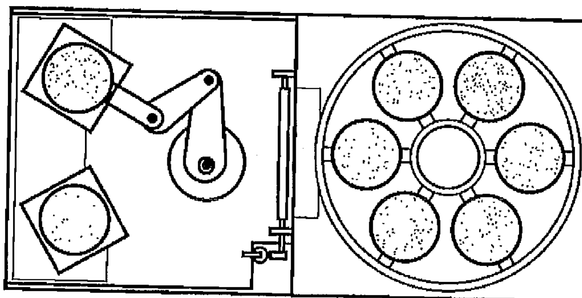
The Concept One is a plasma enhanced chemical vapor deposition (PECVD) system used for the deposition of thin films for interlayer dielectric and passivation applications. It is designed and manufactured for improved reliability and deposits high quality films while lowering wafer cost.

◆ **PROCESS FLEXIBILITY**

The system is capable of depositing **all dielectric films in the same process chamber**, including silicon nitride and doped and undoped silane and TEOS oxides. The Concept One accommodates 100, 125 and 150 mm wafers; the Concept One - 200 handles 125, 150 and 200 mm. Wafer size can be changed in either system **without modification** of the process chamber and with minimal modification of the loadlock.

◆ **HIGH PRODUCTIVITY/ WIDE PROCESS WINDOWS/ FILM QUALITY**

Novellus' multi-station continuous processing design provides **inherently high throughput** without the necessity of maximizing deposition rates. The resulting wide process windows produce consistent film properties over wide parametric ranges. In addition, multiple deposition stations **improve uniformity by averaging out random variations** at each station. The system's simple overall design means higher availability and improved productivity.



The Concept One - 200 depicted above has five deposition stations and one load/unload station in the process chamber. The Concept One has seven deposition stations and one load/unload station.The loadlock accommodates three cassettes except for 200 mm wafers where two cassettes are used.

◆ **PARTICLE CONTROL**

Low particle levels are maintained by deposition in a stable, load locked process chamber which is **neither pressure nor temperature cycled** and is **automatically plasma cleaned** after each batch of wafers. The process chamber has just **one moving part** that contacts the wafer backside only. As a result, improved device yields in a number of different applications have been attained.

◆ **REDUCED HILLOCKS**

Hillocks are a major concern in intermetal dielectric applications, leading to metal-to-metal shorts and lower yields. The Concept One's unique system design eliminates these defects by greatly **reducing the time** at temperature prior to deposition. This means higher yields and lower IC costs.

◆ **DOPANT CONTROL**

Independent and linear control of dopant concentrations is achieved as a result of excess **atomic oxygen** with respect to reactant hydrides.

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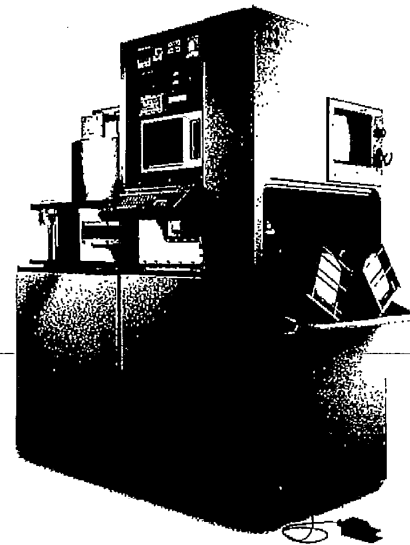
SiO_2, BPSG, PSG
GUARANTEED SPECIFICATIONS

Film Thickness Range	2,000 - 20,000Å
Within-Wafer Thickness Uniformity	100, 125, 150 mm ≤ 1.0% (1 σ) 200 mm ≤ 1.5% (1 σ)
Wafer-to-Wafer Thickness Reproducibility	≤ 1.0% (1 σ)
Run-to-Run Thickness Reproducibility	≤ 1.5% (1 σ)
Refractive Index	1.465 ± 0.015
Film Stress	
Undoped	≤ 1.5 x 10^9 dynes/cm^2 Compressive
Doped	Dopant concentration dependent
Dopant Range	PSG: 0-10 wt% BPSG: 0-5 wt% B 0-7 wt% P
Dopant Uniformity	± 0.1 wt%
Dopant Reproducibility	± 0.2 wt%
Pinholes	≤ 0.01/cm^2
Particles (1000 Å film)	≤ 0.2/cm^2 (Particles ≥ 0.3µm)

Note:
Novellus **guarantees** that films will meet the listed specifications when deposited using standard Novellus process conditions and measured according to Novellus recommended procedures. The above guaranteed specifications apply to 100, 125, 150 and 200 mm wafers, except where noted.

TYPICAL PROCESS PARAMETERS

Chemistry	SiH_4, N_2O, N_2, B_2H_6 (5% in N_2), PH_3 (5% in N_2),
Pressure	2.2 Torr
Temperature	400° C
RF Power	0.4 Watt/cm^2
RF Frequency	13.56 MHz
Deposition Rate	
Undoped	4,400 Å/min
Doped	5,500 Å/min



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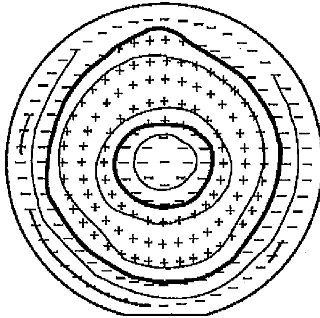
CHARACTERIZATION DATA – UNDOPED SiO_2

Within-Wafer Uniformity

200 mm Wafer

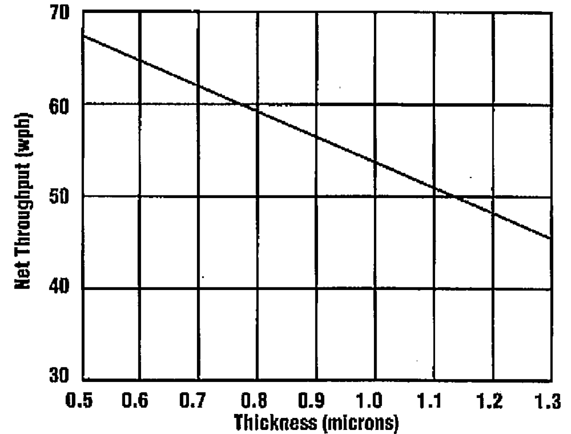


Mean Thickness: 6081Å
Standard Deviation: 0.98% (1 σ)
Interval: 1%

The overall averaging effect of multi-station sequential deposition results in excellent uniformity on wafers as large as 200 mm.

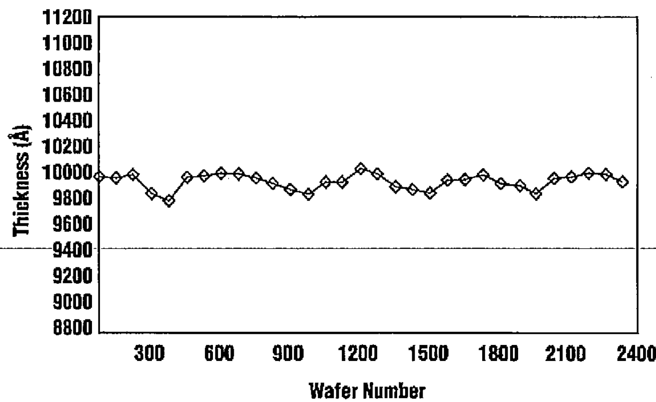
Net System Throughput

(Includes Plasma Clean)



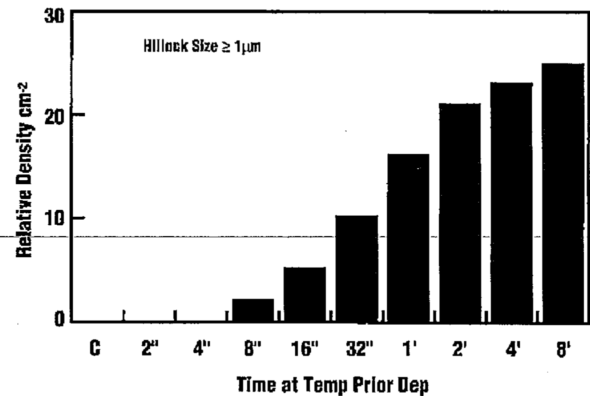
Novellus' multi-station continuous processing design provides high net throughput over a wide range of film thicknesses as demonstrated with the Concept One.

Film Thickness Reproducibility



Good wafer-to-wafer thickness reproducibility is achieved because every wafer sees the same deposition environment. Customer data indicates better than 1% (1 σ) wafer-to-wafer reproducibility over 2,325 consecutive wafers.

Hillock Control



The Concept One minimizes the time at temperature prior to deposition resulting in reduced hillock formation. This time is typically less than eight seconds. Cold deposited aluminum was used in this evaluation.

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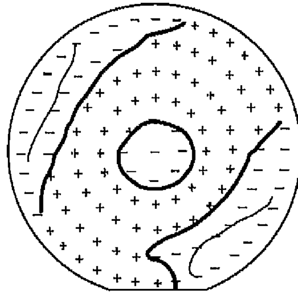
CHARACTERIZATION DATA – DOPED SiO_2

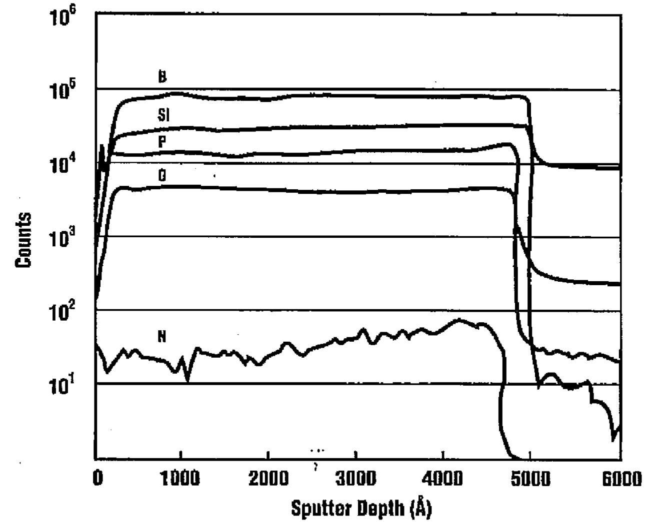
Within-Wafer Uniformity
BPSG – 150 mm Wafer



Mean Thickness: 4409Å
Standard Deviation: 0.80% (1 σ)
Interval: 1%

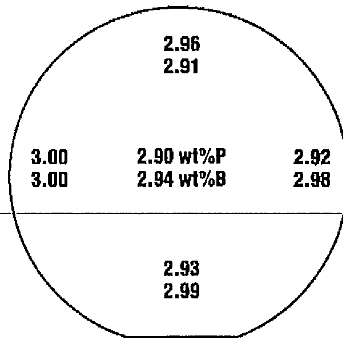
In a multi-station continuous deposition system, improved uniformity is obtained by averaging out the random variations of each deposition station.

SIMS Analysis

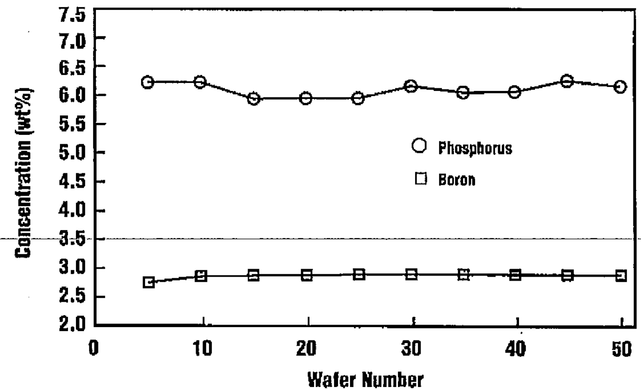


Secondary Ion Mass Spectroscopy (SIMS) analysis of a BPSG film demonstrates constant composition throughout the film.

Within-Wafer Dopant Uniformity
BPSG – 200 mm Wafer



Dopant Reproducibility
BPSG



The multi–station design of the Concept One and the excess atomic oxygen of the PECVD process result in excellent dopant uniformity and reproducibility.

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