

SUNIL KUMAR SINGH

Senior Doctoral Student

Department of Metallurgical Engineering
& Materials Science
Indian Institute of Technology Bombay,
Powai-400076, India



Hostel –1, Room No. 151
Indian Institute of Technology
Bombay
Powai, Mumbai – 400076
Mobile N.: 09323285188
Email: sksingh@iitb.ac.in &
sunil@met.iitb.ac.in

Resume

PROFESSIONAL OBJECTIVE

Seeking excellence in the chosen professional field through self-motivation, hard work and augmentation of core skills required to effectively deliver goods. Striving to achieve excellence through selective and focused pursuit of the short and long-term goals and trying to create an environment through my chosen organization and work field where knowledge and excellence are given their due.

AREAS OF INTEREST

- Deep Sub-micron CMOS Technology
- High and Low-k Dielectrics and their Reliability
- Plasma treatment
- Novel Semiconductor Device Structures
- Barrier layer for Cu diffusion

EDUCATION

Doctor of Philosophy (PhD) in Materials Science

(Department of Metallurgical Engineering and Materials Science Engineering)

Specialization : **Thin films processing (Material Science)**
Institute : **Indian Institute of Technology, Bombay, India**
Joining date : July 2001

Master of Technology (M.Tech) in Materials Science

(Department of Materials Science)

Major : **Materials Science**
Institute : **Institute of Technology, BHU, Varanasi, India**
CPI : **8.93/10.00**
Graduation : April 2001

Master of Science (M.Sc.) in Physics

Major : **Physics**
Institute : **Department of Physics,
BHU, Varanasi, India**
Class : **First Class**
Graduation : June 1998

PROJECTS & SEMINARS UNDERTAKEN

PhD Topic

Development of low dielectric (low-k) thin films for VLSI circuit

Guides: Prof. R. O. Dusane (Department of Metallurgical Engg. and Materials Science)

Spin on Hydrogen silsesquioxane (HSQ) is a material having low dielectric constant (k) and shows potential as intermetal dielectric (IMD) layers for future ULSI technology. Cu diffusion in the HSQ is a major obstacle in the low-k plus Cu technology for future ULSI devices. HWCVD had shown promise to synthesize good quality a-SiC:H films for barrier layer at low substrate temperature (250°C) while maintaining their obvious advantages of higher dielectric constant of 4.2, lower leakage current & higher breakdown fields. We looked at oxygen, nitrogen and hydrogen plasma process of HSQ. Our exhaustive electrical characterizations show that H₂ plasma is more useful for passivating dangling bonds. H₂ plasma also reduces leakage current and moisture absorption of low-k materials. We studied the moisture recovery by TMCS (Tri Methyl Chloro Silane) treatment. This treatment on the low-k material removes moisture, which is observed during photoresist removal. In order to inhibit moisture absorption and the subsequent degradation of the properties we have carried out hot wire generated atomic hydrogen treatment of the HSQ films. To study the moisture resistance of these treated HSQ films, the effect of moisture penetration was evaluated by accelerated water treatment tests and subsequent determination of the I-V characteristics.

Hot Wire Chemical Vapor Deposition(HWCVD) a novel technique has been used as a low cost, low temperature technique to produce alloys of silicon nitride and amorphous silicon carbide (a-SiC:H). The a-SiC:H films are known as good diffusion barrier layer for Cu diffusion. These films were physically characterized by ellipsometer, FTIR, AFM, XPS etc. MIS capacitors are fabricated using HWCVD a-SiC:H as a barrier layer and HSQ as a low-k dielectric material. These are further electrically characterized using DC-IV, HFCV measurements. The MIS structure using Cu/a-SiC:H/HSQ/<Si> showed less Cu diffusion (~8 nm) in low - k as compared to other barrier layers.

M.Tech Project

1. Title: Preparation and characterization of Barium-Strontium-Titanate (BST-16) high dielectric powder by ceramic route.

Supervisor: *Prof. D. Pandey*

Email: dpandey@babaras.ac.in

Coordinator of School of Materials Science and Technology

Institute of Technology, BHU, Varanasi

2. Title: Influence of bond coating processes on the stability of thermal barrier coating on super alloy C-263

Supervisor: *Prof. Vakil Singh*

Email: vakil@babaras.ac.in

Dept. of Met. Engg. Institute of Technology, BHU, Varanasi

M.Sc. project

Title: Ionization cross-section of M-shell of Bi and Au by 1MeV proton impact

Supervisor: *Prof. R. Shanker*

Dept. of Physics, Banaras Hindu University, Varanasi

EXPERIENCE IN SEMICONDUCTOR PROCESSING

Working in Microelectronics lab (Class 1000) of Department of Electrical Engineering at *I.I.T. Bombay, INDIA* since last six years. I am having expertise on following systems: -

- Three zone Oxidation/Diffusion Furnaces from M/sTempress, General signal, Model 201
- Novel Pulsed Plasma Immersion Ion Implantation (PIII) using Pulsed DC, RF and DC continuous.
- Thermal Evaporation system M/s HindHivac Vacuum systems
- Novel Hot Wire CVD System (horizontal)
- DC and RF Plasma Sputtering System.
- RCA and Ultra sonic cleaning set up.
- Ellipsometer M/s Sentech Instruments (SE 800)

TEACHING ASSISTANTSHIP

IIT Bombay, Duration: July 2001- July 2005

During this period, I worked as a Teaching Assistant with

1. **Prof. B. P. Kashyap**, for Microstructure development, heat treatment, Tensile and Compressive test laboratory for M. Tech students.

2. **Prof. Om. Prakash**, for the course of Electrical and Magnetic materials and for undergraduate students and Superconductivity for post graduate students.
3. **Prof. R. O. Dusane**, for vacuum coating experiment for graduate students.

SPECIAL AWARDS & CERTIFICATES

- Qualified UGC-NET in June 2000
- Qualified Gate-1999
- Qualified JEST, 2000

PERSONAL DETAILS

Date of Birth : 12th August 1976
Age : 29 yrs.
Marital Status : Single

NAME AND ADDRESSES OF REFEREES:

Prof. Rajiv O.Dusane
Professor
Department of Metallurgical Engineering
and Materials Science
Indian Institute of technology, Bombay,
India
E-mail: rod@met.iitb.ac.in

Prof. Om Prakash
Professor
Department of Metallurgical Engineering
and Materials Science
Indian Institute of technology, Bombay,
India
E- mail: prakasho@met.iitb.ac.in

PUBLICATIONS

- A. Kumbhar, **S. K. Singh**, A. Srivastav and R. O. Dusane, Proc. 12th IWPSD-2003, Vol. 1, pg.268.
- Potential of Cat-CVD deposited a-SiC:H as diffusion barrier layer on Low-k HSQ films for VLSI.. **Sunil Kumar Singh**, Alka A. Kumbhar, Mayur Kothari and R. O. Dusane, Accepted in Thin solid Films.
- Enhancement of moisture resistance of spin-on Low-k films by Hot-wire generated atomic hydrogen treatment. Alka A. Kumbhar, **Sunil Kumar Singh** and R. O. Dusane, Accepted in Thin solid Films.
- HWCVD a-SiC:H as a Cu diffusion barrier layer for IC fabrication, **Sunil Kumar Singh**, Alka A. Kumbhar, Mayur Kothari and R. O. Dusane, Communicated to Surface and Coating Technology.

- The Effect of O₂ Plasma treatment on Low Dielectric Constant HSQ Films, **Sunil Kumar Singh**, Alka A. Kumbhar and R. O. Dusane, Presented at the Workshop on Plasma Surface Engineering, BARC, 23-25 Sept. 2004.

- Repairing plasma damaged low-k HSQ films with Trimethylchlorosilane treatment. **Sunil Kumar Singh**, Alka A. Kumbhar and R. O. Dusane, Communicated to Applied Surface Science.

- HWCVD deposited nanometer thick a-SiC:H diffusion barrier films for ULSI application, **S. K. Singh**, A. A. Kumbhar, R. O. Dusane and W. Bock, Communicated to Journal of Vacuum Science & Technology A.