

CONTENTS

Legend: "Topic (page number)"

Introduction (1)

CMOS process flow (3)

- active areas and isolation region formation (4)
- LOCOS (4)
- STI (6)
- CMP (7)
- wells formation (9)
- annealing (10)
- activation (10)
- thermal budget (12)
- PE-CVD (14)
- SOD (15)
- gate stack formation (16)
- source and drain junctions formation (19)
- spacers formation (22)
- local interconnect and active area metallization (26)
- contacts formation (28)

Defects (36)

- point defects (36)
- line defects / dislocations (40, 53)
- area defects (42)
- volume defects (43)

Czochralski technique (45)

- pull rate (46, 56)
- doping of Si during CZ growth (47)
- maximum pull rate calculation (56)
- wafer preparation: next steps (48)
- calculation of point defects concentration (54)
- dopant segregation in CZ (59)

Silicon oxidation (61)

- impurities in SiO₂ (63)
- silicon oxidation kinetics (65)
- Deal and Grove model (66)
- Massoud model (73)
- other factors that influence oxidation rates (74)
- 2D oxidation (78)

- charges in SiO₂ (79)
- CV characterization of SiO₂ (81)
- nitridation (89)
- silicon oxidation equipments (90)
- rapid thermal oxidation (91)
- radical oxidation (92)
- plasma oxidation (93)
- alternative gate oxides (94)
- how to measure SiO₂ thickness (95)

Dopant diffusion (96)

- Fick's laws (98)
- delta-function dose (100)
- diffusion from infinite source of dopants (102)
- diffusion from surface with constant concentration of dopants (104)
- diffusivity (105)
- corrections to Fick's laws (106, 116)
- atomic scale diffusion (109)
- oxidation enhanced / retarded diffusion (110)
- emitter push (112)
- modeling of atomic scale diffusion (113, 118)
- SIMS - secondary ion mass spectrometry (114)
- SSRM - scanning spreading resistance microscopy (115)

Ion implantation (122)

- ion source and extractor (125)
- ion analyzer (124)
- ion accelerator (125)
- concentration distribution (127)
- stopping power and masking (128)
- channeling (131)
- stopping mechanisms (132)
- nuclear stopping (133)
- electronic stopping (134)
- damage (135)
- SPE – solid phase epitaxy (136)
- +1 model (139)
- electrical activation (140)
- TED – transient enhanced diffusion (142)

Thin film deposition (146)

- CVD, APCVD (148)
- basic transport mechanisms (149)
- stagnant layer (152)
- flux equations for APCVD (154)
- LPCVD (157)

- PECVD (158)
- sheaths / dark regions (160)
- HDPCVD (162)
- ALD (164)
- PVD, evaporation (165)
- deposition rate: point source (166)
- deposition rate: small planar source (167)
- evaporation rate (168)
- sticking coefficient (169)
- sputter deposition (170)
- DC sputter deposition (171, 174)
- RF – AC sputter deposition (172)
- sputtering yield (175)
- arrival angle distribution (176)
- other sputtering processes...(177)
- model of CVD and PVD (179)
- LPCVD modelling (183)
- PECVD modelling (184)
- PVD modelling (185)
- ionized PVD modelling (185)

Lithography (188)

- illumination source: g, h, i line (190)
- photo masks (191)
- wafer exposure systems (193)
- contact printing (194)
- proximity printing (195)
- exposure systems comparison (196)
- projection printing (197)
- stepper and scanner (200)
- photoresist process (201)
- g-line and i-line photoresists (203)
- positive g-line and i-line chemical process (204)
- deep UV photoresists (205)
- chemically amplified resist (206)
- resist contrast (207)
- process flow of the wafer in a lithographic system (209)
- registration (213)
- numerical aperture (216)
- partial coherence (217)
- aerial image formation (218)
- mask spectrum (221)
- resolution limit of coherent imaging (224)
- resolution limit of partially coherent imaging (228)
- depth of focus (230)
- resolution enhancement techniques (233)
- off axis illumination (234)

- attenuated phase shift masks (235)
- optical proximity corrections (236)
- sub resolution assist features (237)
- immersion lithography (239)
- double patterning (241)
- self aligned double patterning (242)
- imbalanced pattern (247)
- electron beam direct writing (249)
- extreme UV lithography (250)
- nano imprint lithography (251)
- directed self assembly (252)

Etching (253)

- wet etching (254)
- plasma etching / dry etching (255)
- plasma etching basic mechanisms (256)
- ion enhanced etching (259)
- ion enhanced inhibitor etching (260)
- etching tools (261)
- end point detection (264)
- plasma etching issues (268)
- antenna effect (270)
- plasma etching chemistries (271)
- etching models (273)

Back End Of the Line (276)

- local interconnects (278)
- contacts (281)
- intermediate / global interconnects (284)
- Aluminum hillocks and voids (285)
- dielectrics (287)
- signal time delay (289)
- damascene approach (291)
- Copper process flow (291)
- Copper main issues (295)
- electromigration (297)
- "MTTF" vs "line width / grain size" (299)
- electromigration qualitative model (300)
- electromigration analytical model (302)