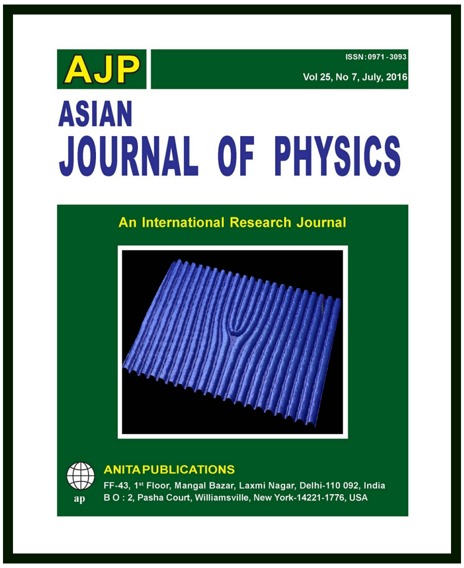
An International Research Jou



AJP

25th Anniversary Year of AJP-201

Accepted papers: Vol 25, No 7, 201
Special Section on
“Micro and nano-optics"
Edited by
Shanti Bhattacharya, Saulius Juodkazis and R

Short Note on the SERB school on Optical Metrology conducted i

By Dr. Shanti Bhattacharya, Department of Electrical Engineerin
With inputs from Prof (Dr.) Rajpal S. Sirohi, Tez

A SERB school on Optical Metrology was recently conducted by the Department of Physics, Te
were Dr. Rajpal S. Sirohi, BRLGB Chair professor, Tezpur University and Dr. Gazi A. Ahmed, H
process for conduct of the school started in 2014 and the first meeting of the Planning Commi
school, the speakers and other relevant points were decided in that meeting. Approval for the
1st to June 21st, 2016.

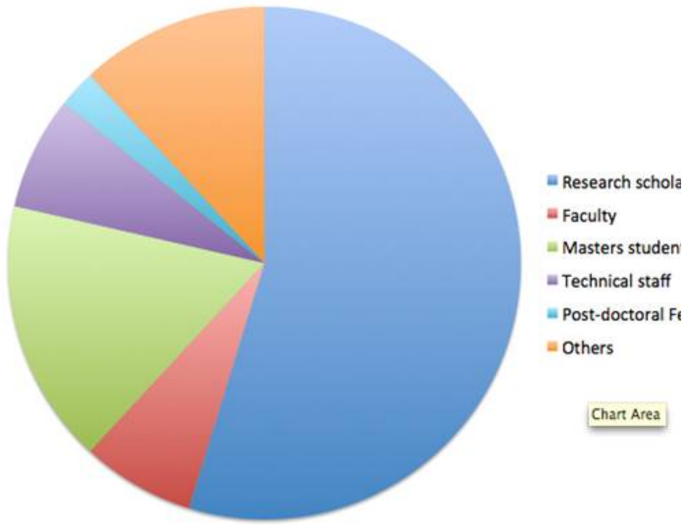


Fig 1. Background of participants

From the applications, a committee shortlisted 50 candidates for the school, which finally had
fig.1, most participants were research scholars. Also, although the majority was from Assar
country, as seen in the bar chart of fig 2.

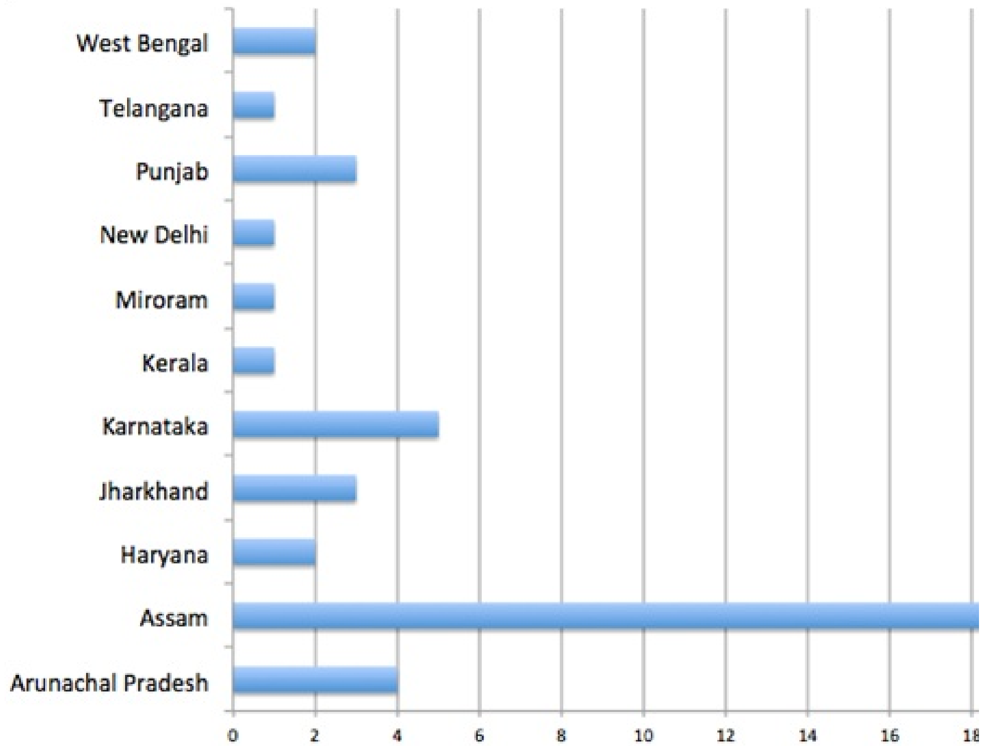


Fig 2. States from which participants attende

The school was conducted six days a week with lectures from 9 am till 4pm, after which there w

I had the privilege of teaching at this school on 18th June and was pleased to find the students classes and lab sessions. This could be attributed to the high quality of teachers and topics cove like IIT Delhi (Kehar Singh, Chandra Shakher, P. Senthilkumaran), IIT Guwahati (Bosanta Bo Shanti Bhattacharya), Calcutta University (L. N. Hazra) and Tezpur University(R. S. Sirohi, Pab well as from government research labs such as IRDE, Dehradun (A. K. Gupta and Amitava Gh Kumar Swami).

The topics within the field of Optical Metrology were diverse and ranged from sources & dete with fibre optics, MEMS, Vortex beams and metrology of biological systems, to mention just a fe

One unique feature of this school was that students were given time to present their research fellow attendees and the schools directors.

All in all, this was a well-organised and useful school that will benefit its participants in both th

Asian Journal of Physics

Spatial light modulator based Fresnel incoherent

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The ever-going progress of spatial light modulators (SLMs) technology greatly contributes to t recorders. In this review paper, the role of these devices in Fresnel incoherent correlation h FINCH in the last decade is described and discussed; emphasis is given to the SLM part in the sy

Keywords: Spatial light modulators (SLMs), Digital hologram (DHs), Computer generated holo

Total Refs:59

Asian Journal of Physics

Graphene: A review of optical properties and phot

M K Kavitha and Manu Jaiswal

Department of Physics, Indian Institute of Technology Madras, C

This article gives a brief overview of the broad-range optical response of graphene and its scop of single-layer graphene is unique, since it is governed entirely by a fundamental constant of frequency dependence or a dependence on any material properties are noteworthy characteris is discussed with regard to its peculiar band structure and the massless relativistic nature of its c to modulate the optical absorption, since it modifies the position of the Fermi energy in evaluation of the optical response of graphene using spectroscopic ellipsometry is discussed

counterpart of graphene that can be solution-processed. Its optical properties can be varied by
optical properties of defected graphene are discussed and the important contribution of confin
is also highlighted. Finally, interesting photonic applications in photodetectors, non-linear o
combination of unique electronic and optical properties of graphene and its derivatives are sum
Keywords: Graphene, Fine-structure constant, Electrostatic gating, Spectroscopic Ellipsometry
Total Refs: 136

1. **Castro Neto A H, Guinea F, Peres N M R, Novoselov K S, Geim A K, *Rev Mod Phys*, 81(2009**
2. **Nair R R, Blake P, Grigorenko A N, Novoselov K S, Booth T J, Stauber T, Peres N M R, Gein**
3. Blake P, Hill E W, Castro Neto A H, Novoselov K S, Jiang D, Yang R, Booth T J, Geim A K, *App*
4. Wang F, Zhang Y, Tian C, Girit C, Zettl A, Crommie M, Shen Y R, *Science*, 320(2008) 206-.
5. Horng J, Chen Chi-Fan, Geng Baisong, Girit Caglar, Zhang Yuanbo, Hao Zhao, Bechtel Han Shen Y Ron, Wang Feng, *Phys Rev B*, 83(2011)165113; doi.org/10.1103/PhysRevB.83.165113
6. Ju L, Geng B, Horng J, Girit C, Martin M, Hao Z, Bechte Hans A, Liang X, Zettl A, Shen Y. Ro
7. Lui C H, Mak K F, Shan J, Heinz T F, *Phys Rev Lett*, 105(2010)127404; doi.org/10.1103/PhysRe
8. Bao Q, Zhang H, Wang Y, Ni Z, Yan Y, Shen Z X, Loh K P, Tang D Y, *Adv Funct Mater*, 19(20
9. Lijin G, Aparna G, Shaina P R, Nandita Das G, Manu J, *Nanotechnology*, 26(2015)495701-.
10. Wallace P R, *Phys Rev*, 71(1947) 622-.
11. Reich S, Maultzsch J, Thomsen C, Ordejón P, *Phys Rev B*, 66(2002) 035412-.
12. Novoselov K S, Geim A K, Morozov S V, Jiang D, Katsnelson M I, Grigorieva I V, Dubonos S V
13. Kittel C, Introduction to Solid State Physics, 7th Edn. (Wiley), 1996-.
14. Mintmire J W, White C T, *Phys Rev Lett*, 81(1998)2506-.
15. Pachoud A, Jaiswal M, Ang P K, Loh K P, Özyilmaz B, *Europhys Lett*, 92(2010)27001-
16. E. McCann D S L A, V. I. Fal'ko, Eur Phys J-Spec Top, 148(2007)91
17. George L, Jaiswal M, ICC-2015, Bikaner, (2016) AIP conference proceedings in press
18. Yu Q, Lian J, Siriponglert S, Li H, Chen Y P, Pei S S, *Appl Phys Lett*, 93(2008)113103-.
19. Guermoune A, Chari T, Popescu F, Sabri S S, Guillemette J, Skulason H S, Szkopek T, Siaj M
20. Strudwick A J, Weber N E, Schwab M G, Kettner M, Weitz R T, Wünsch J R, Müllen K, Sachd
21. Bae S, et al., *Nat Nano*, 5(2010)574-.
22. Novoselov K S, Geim A K, Morozov S V, Jiang D, Zhang Y, Dubonos S V, Grigorieva I V, Firso
23. Norimatsu W, and Kusunoki M, *Phys Chem Chem Phys*, 16(2014)3501-.
24. Pallecchi E, Lafont F, Cavaliere V, Schopfer F, Mailly D, Poirier W, Ouerghi A, *Sci Rep*, 4(2014
25. Riedl C, Coletti C, Starke U, *J Phys D Appl Phys*, 43(2010)374009-.
26. Pei S, Cheng H M, *Carbon*, 50(2012)3210-.
27. Somani P R, Somani S P, Umeno M, *Chem Phys Lett*, 430(2006)56-.
28. Kosynkin D V, Higginbotham A L, Sinitskii A, Lomeda J R, Dimiev A, Price B K, Tour J M, *Na*
29. Jiao L, Zhang L, Wang X, Diankov G, Dai H, *Nature*, 458(2009) 877-.
30. Eda G, Fanchini G, Chhowalla M, *Nat Nano*, 3(2008)270-.
31. Stankovich S, Dikin D A, Piner R D, Kohlhaas K A, Kleinhammes A, Jia Y, Wu Y, Nguyen S T,
32. Mak K F, Sfeir M Y, Wu Y, Lui C H, Misewich J A, Heinz T F, *Phys Rev Lett*, 101(2008)196405-.
33. Gierz I, et al., *Nat Mater*, 12(2013)1119-.

34. Mak K F, Ju L, Wang F, Heinz T F, *Solid State Commun*, 152(2012)1341-.
35. Kim J, et al., *Nano Lett*, 12(2012)5598-.
36. Pyykko P, Desclaux J P, *Acc Chem Res*, 12(1979)276-.
37. Christensen N E, Seraphin B O, *Phys Rev B*, 4(1971)3321-.
38. Feynman R P, QED: The Strange Theory of Light and Matter. (Princeton University Press IS
39. Shaina P R, Jaiswal M, *Appl Phys Lett*, 105(2014)193103-.
40. Ni G X, Yang H Z, Ji W, Baeck S, Toh C T, Ahn J H, Pereira V M, Özyilmaz B, *Adv Mater*, 26(2
41. Jaiswal M, Sangeeth C S, Wang W, Sun Y P, R M, *J Nanosci Nanotechnol*, 9(2009)6533
42. Weisman R B, and Bachilo S M, *Nano Lett*, 3(2003)1235-.
43. Kataura H, Kumazawa Y, Maniwa Y, Umezu I, Suzuki S, Ohtsuka Y, Achiba Y, *Synthetic Met*
44. Jaiswal M, Ph D Thesis, Indian Institute of Science, Bangalore, India, 2008.
45. Mak K F, Lui C H, Shan J, Heinz T F, *Phys Rev Lett*, 102(2009)256405-.
46. Brodie B, *Ann Chim Phys*, 59(1860)466-.
47. Staudenmaier L, *Ber Dtsch Chem Ges*, 31(1898)1481-.
48. Hummers W S, Offeman R E, *J Am Chem Soc*, 80(1958)1339-.
49. Marcano D C, Kosynkin D V, Berlin J M, Sinitskii A, Sun Z, Slesarev A, Alemany L B, Lu W, T
50. Eda G, Chhowalla M, *Adv Mater*, 22(2010)2392-.
51. Kajen R S, Chandrasekhar N, Pey K L, Vijila C, Jaiswal M, Saravanan S, Ng A M H, Wong C P
52. Eda G, Mattevi C, Yamaguchi H, Kim H, Chhowalla M, *J Phys Chem C*, 113(2009)15768-.
53. Loh K P, Bao Q, Eda G, Chhowalla M, *Nat Chem*, 2(2010)1015-.
54. Gómez-Navarro C, Weitz R T, Bittner A M, Scolari M, Mews A, Burghard M, Kern K, *Nano L*
55. Becerril H A, Mao J, Liu Z, Stoltenberg R M, Bao Z, Chen Y, *ACS Nano*, 2(2008) 463
56. Park S, An J, Potts J R, Velamakanni A, Murali S, Ruoff R S, *Carbon*, 49(2011) 3019
57. Shin H J, Kim K K, Benayad A, Yoon Seon-Mi, Park H K, Jung I-S, Jin M H, Jeong H-K, Kim J
19(2009)1987-1992.
58. Tao Y, Varghese B, Jaiswal M, Wang S, Zhang Z, Oezyilmaz B, Loh K P, Tok E S, Sow C H, *Ap*
59. Zhou Y, Bao Q, Varghese B, Tang L A L, Tan C K, Sow C-H, Loh K P, *Adv Mater*, 22(2010)67-.
60. El-Kady M F, Kaner R B, *Nat Commun*, 4(2013)1475-.
61. Boukhvalov D W, Katsnelson M I, *J Am Chem Soc*, 130(2008) 10697-.
62. Pereira V M, Lopes dos Santos J M B, Castro Neto A H, *Phys Rev B*, 77(2008)115109-.
63. Shen Y, et al., Carbon, 62(2013)157
64. Johari P, Shenoy V B, *ACS Nano*, 5(2011) 7640-.
65. Acik M, Lee G, Mattevi C, Pirkle A, Wallace R M, Chhowalla M, Cho K, Chabal Y, *J Phys Che*
66. Acik M, Mattevi C, Gong C, Lee G, Cho K, Chhowalla M, Chabal Y J, *ACS Nano*, 4(2010)5861
67. Weber J W, Calado V E, van de Sanden M C M, *Appl Phys Lett*, 97(2010)091904-.
68. Kravets V G, Grigorenko A N, Nair R R, Blake P, Anissimova S, Novoselov K S, Geim A K, *Phy*
69. Losurdo M, Giangregorio M M, Bianco G V, Capezzuto P, Bruno G, *Thin Solid Films*, 571(20
70. Isi G, et al., *J Nanophotonics*, 5(2011)051809.
71. Li W, Cheng G, Liang Y, Tian B, Liang X, Peng L, Hight Walker A R, Gundlach D J, Nguyen N

72. Ghosh M, Pradipkanti L, Rai V, Satapathy D K, Vayalamkuzhi P, Jaiswal M, *Appl Phys Lett*, 1
73. Shen Y, Zhou P, Sun Q Q, Wan L, Li J, Chen L Y, Zhang D W, Wang X B, *Appl Phys Lett*, 99(2
74. Nelson F J, Kamineni V K, Zhang T, Comfort E S, Lee J U, Diebold A C, *Appl Phys Lett*, 97(20
75. Fujiwara H, Principles of Optics. In Spectroscopic Ellipsometry, (John Wiley & Sons, Ltd), 2
76. Fujiwara H, Data Analysis. In Spectroscopic Ellipsometry, (John Wiley & Sons, Ltd), 2007, p
77. Wurstbauer U, Röling C, Wurstbauer U, Wegscheider W, Vaupel M, Thiesen P H, Weiss D, *A*
78. Matkovi A, Beltaos A, Mili evi M, Ralevi U, Vasi B, Jovanovi D, Gaji R, *J Appl Phys*, 112(201
79. Yang L, Deslippe J, Park C-H, Cohen M L, Louie S G, *Phys Rev Lett*, 103(2009)186802-.
80. Zhou K G, Chang M J, Wang H X, Xie Y L, Zhang H L, *J Nanosci Nanotechnol*, 12(2012)508-.
81. Nair R R, Wu H A, Jayaram P N, Grigorieva I V, Geim A K, *Science*, 335(2012)442-.
82. Han S, Choi M Y, Kumar P, Stanley H E, *Nat Phys*, 6(2010)685-.
83. Algara Siller G, Lehtinen O, Wang F C, Nair R R, Kaiser U, Wu H A, Geim A K, Grigorieva I V,
84. Zhou W, et al., *Nature*, 528(2015)E1.
85. Sobrino Fernández Mario, M. Neek Amal, Peeters F M, *arXiv*:1601.06073, (2016)
86. Abergel D S L, Russell A, Fal'ko V I, *Appl Phys Lett*, 91(2007)063125.
87. Roddaro S, Pingue P, Piazza V, Pellegrini V, Beltram F, *Nano Lett*, 7(2007)2707-
88. Sarkar B, M Sc Thesis, Indian Institute of Techology Madras, Chennai, India, 2013
89. Chen C F, et al., *Nature*, 471(2011)617.
90. Eda G, Lin Y Y, Mattevi C, Yamaguchi H, Chen H-A, Chen I S, Chen C-W, Chhowalla M, *Ad*
91. Chien C T, et al., *Angew Chem*, 51(2012)6662.
92. Pan D, Zhang J, Li Z, Wu M, *Adv Mater*, 22(2010)734-
93. Xin G, Meng Y, Ma Y, Ho D, Kim N, Cho S M, Chae H, *Mat Lett*, 74(2012)71-
94. Zhuo S, Shao M, Lee S T, *ACS Nano*, 6(2012)1059-
95. Shen J, Zhu Y, Yang X, Zong J, Zhang J, Li C, *New J Chem*, 36(2012)97-
96. Jin S H, Kim D H, Jun G H, Hong S H, Jeon S, *ACS Nano*, 7(2013)1239-
97. Wang X, Zhi L, Müllen K, *Nano Lett*, 8(2008)323-
98. Wu J, Agrawal M, Becerril H A, Bao Z, Liu Z, Chen Y, Peumans P, *ACS Nano*, 4(2010)43-
99. Sangeeth C S S, Jaiswal M, Menon R, *J Appl Phys*, 105(2009)063713-
100. Shi H, Wang C, Sun Z, Zhou Y, Jin K, Yang G, *Sci China Phys Mech Astron*, 58(2014)1-
101. Moon I K, Kim J I, Lee H, Hur K, Kim W C, Lee H, *Sci Rep*, 3(2013)1112-
102. He Q, Wu S, Gao S, Cao X, Yin Z, Li H, Chen P, Zhang H, *ACS Nano*, 5(2011)5038-
103. Fan J, Liu S, Yu J, *J Mater Chem*, 22(2012)17027.
104. Anish Madhavan A, Kalluri S, K Chacko D, Arun T A, Nagarajan S, Subramanian K R V, Sree
2(2012)13032-
105. Chen T, Hu W, Song J, Guai G H, Li C M, *Adv Funct Mater*, 22(2012)5245-
106. Zhang D W, Li X D, Li H B, Chen S, Sun Z, Yin X J, Huang S M, *Carbon*, 49(2011)5382-
107. Choi H, Kim H, Hwang S, Choi W, Jeon M, *Sol Energy Mater Sol Cells*, 95(2011)323-.
108. Lee K S, Lee Y, Lee J Y, Ahn J-H, Park J H, *Chem Sus Chem*, 5(2012)379-
109. Kaniyoor A, Ramaprabhu S, *J Appl Phys*, 109(2011)124308-

110. Wang J T-W, Ball J M, Barea E M, Abate A, Alexander-Webber J A, Huang J, Saliba M, Mora-S
14(2014)724-730.
111. Yan K, Wei Z, Li J, Chen H, Yi Ya, Zheng X, Long X, Wang Z, Wang J, Xu J, Yang S, *Small*, 11(
112. Wu Z, et al., *Nanoscale*, 6(2014)10505.
113. You P, Liu Z, Tai Q, Liu S, Yan F, *Adv Mater*, 27(2015)3632-.
114. Lang F, Gluba M A, Albrecht S, Rappich J, Korte L, Rech B, Nickel N H, *J Phys Chem Lett*, 6(
115. Han T H, Lee Y, Choi M R, Woo S H, Bae S H, Hong B H, Ahn J H, Lee T W, *Nat Photon*, 6(2
116. Li N, Oida S, Tulevski G S, Han S J, Hannon J B, Sadana D K, Chen T C, *Nat Commun*, 4(20
117. Sun T, Wang Z L, Shi Z J, Ran G Z, Xu W J, Wang Z Y, Li Y Z, Dai L, Qin G G, *Appl Phys Lett*,
118. Chang J H, Lin W H, Wang P C, Taur J I, Ku T A, Chen W T, Yan S J, Wu C I, *Sci Rep*, 5(2015)9
119. Tielrooij K J, et al., *Nat Nano*, 10(2015)437.
120. Xia F, Mueller T, Lin Y-m, Valdes-Garcia A, Avouris P, *Nat Nano*, 4(2009)839-
121. Echtermeyer T J, et al., *Nano Lett*, 14(2014)3733
122. An Y, Behnam A, Pop E, Ural A, *Appl Phys Lett*, 102(2013)013110-.
123. Echtermeyer T J, Milana S, Sassi U, Eiden A, Wu M, Lidorikis E, Ferrari A C, *Nano Lett*, 16(20
124. Zhang H, Bao Q, Tang D, Zhao L, Loh K, *Appl Phys Lett*, 95(2009)141103-
125. Bao Q, Zhang H, Yang J-x, Wang S, Tang D Y, Jose R, Ramakrishna S, Lim C T, Loh K P, *Adv
126. Purdie D G, Popa D, Wittwer V J, Jiang Z, Bonacchini G, Torrisi F, Milana S, Lidorikis E, Ferr
127. Tolstik N, Sorokin E, Sorokina I T, *Opt Express*, 22(2014)5564
128. Mishra S R, Rawat H S, Mehendale S C, Rustagi K C, Sood A K, Bandyopadhyay R, Govindar
129. Zhu P, Wang P, Qiu W, Liu Y, Ye C, Fang G, Song Y, *Appl Phys Lett*, 78(2001)1319-
130. Haripadmam P C, Kavitha M K, John H, Krishnan B, Gopinath P, *Appl Phys Lett*,101(2012)0
131. Kavitha M K, Haripadmam P C, Gopinath P, Krishnan B, John H, *Mater Res Bull*, 48(2013)1
132. Cao B, Zhang Y, Zhang H, Zhu J, *Chin Opt Lett*, 3(2005)S248-
133. Kavitha M K, John H, Gopinath P, Philip R, *J Mater Chem C*, 1(2013)3669-
134. Zhao M, Peng R, Zheng Q, Wang Q, Chang M J, Liu Y, Song Y L, Zhang H L, *Nanoscale*, 7(20
135. Liu Z B, Xu Y F, Zhang X Y, Zhang X L, Chen Y S, Tian J G, *J Phys Chem B*, 113(2009)9681-96
136. Kavitha M K, Ph D Thesis, Indian Institute of Space Science and Technology, Thiruvanant

Graphene: A review of optical properties and photonic applications.pdf
M K Kavitha and Manu Jaiswal

Asian Journal of Physics

Focused ion beam milling for the fabrication of beam-shaping

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Focused ion beam (FIB) milling is a versatile technique for direct fabrication of micro/nano o

substrates for a wide range of applications. The fabrication of fork-shaped gratings (FSGs) and s
kV Ga+ ion beam is presented. Scanning electron microscopy images demonstrate the realiz
plate with good structural quality. The generation of donut beam could be demonstrated by opt
Keywords: Diffractive optical elements (DOEs), Spiral phase plates (SPPs), Focused Ion beam li
Total Refs : 23

Focused ion beam milling for the fabrication of beam-shaping spiral phase optical elem
Pramitha Vayalamkuzhi and Shanti Bhattacharya

Asian Journal of Physics

Integrated optical position sensor for MEM

S Richter, G Krampert, U Wolf, L Riedel and D Do
Carl Zeiss AG, Corporate Research and Technology, Carl Zeiss Promenad

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We report on a position sensing system for quasistatic MEMS mirrors using a point source
position signal is detected by a 4-quadrant-diode and can be used for digital closed-loop co
sampling frequency of 500 ksps. The whole detection system is miniaturized and integrated in
beam path as well as the amplifier circuit of the 4-quadrant-diode.
Keywords: MEMS, Scanning mirrors, Beam steering, closed loop control, 4-quadrant diode.
Total Refs: 8

Asian Journal of Physics

Tunable optical submicron structures based o

Wolfgang Mönch
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Tunable, active, adaptive and variable optics has experienced a steep development during the
the individual segments of, for example large mirror were actuated individually by mechanical
optical elements. Soft matter brings along with it a wealth of effects that are new in the field o
time an introductory tutorial and a short review, describes the current status in a sub-field of tu
on submicron structures. This scope encompasses all types of diffracting elements, Bragg mirro
the introduction, we give a concise overview on the material basics and the fundamentals of t
overview on the state of the field as found in scientific literature. The article closes with son
Publications.
Keywords: Adaptive optics. Bragg mirrors, Diffracting elements
Total Refs: 97
1. Zappe Hans, Duppé Claudia (eds), Tunable Micro-optics, (Cambridge University Press, Cam

2. Brunner Robert, Transferring diffractive optics from research to commercial applications: P
Optical Technologies, 2(2013)351-359.
3. Brunner Robert, Transferring diffractive optics from research to commercial applications: P
Technol, 3(2014)121-128.
4. Jones Richard A L, Soft Condensed Matter, (Oxford University Press, Oxford/New York), 200
5. Israelachvili Jacob N, Intermolecular & Surface Forces, 2nd edn, (Academic Press), 1991.
6. Evans D Fenell, Wennerström Hakan, The Colloidal Domain, Where Physics, Chemistry, Bi
New York), 1994.
7. Chaikin P M, Lubensky T C, Principles of condensed matter physics, (Cambridge University
8. Davis H Ted, Statistical Mechanics of Phases, Interfaces, and Thin Films, (VCH Publishers,
9. Born Max, Wolf Emil. Principles of Optics, 7th edn, (Cambridge University Press, Cambridg
10. Moshrefzadeh R S, Radcliffe M D, Lee T C, Mohapatra S K, Temperature dependence of ind
Lightwave Technol, 10(1992)420-425.
11. Kawai Heiji, The Piezoelectricity of Poly (Vinylidene Fluoride), *Jpn J Appl Phys*, 8(1969)975-9
12. Pelrine Ron, Kornbluh Roy, Pei Qibing, Joseph Jose, High-Speed Electrically Actuated Elast
287(2000)836-839.
13. Warner Mark, Terentjev Eugene Michael, Liquid Crystal Elastomers, (Oxford University Pres
14. Finkelmann Heino, Kock Hans-J, RehageGünther, Investigations on Liquid Crystalline Poly
Type of Liquid Crystalline Material, *Macromol Chem Rapid Comm*, 2(1981)317-322.
15. Schuhladen Stefan, Preller Falko, Rix Richard, Petsch Sebastian, Zentel Rudolf, Zappe Hans
Crystal Elastomers, *Adv Mat*, 26(2014)7247-7251.
16. Flory Paul J, Principles of Polymer Chemistry, (Cornell University Press, Ithaca, New York),
17. Cowie J M G, Polymers: Chemistry & Physics of Modern Materials, (Nelson Thornes Ltd., Cl
18. Sperling Leslie H, Introduction to Physical Polymer Science, (John Wiley & Sons, New York
19. Naylor Tim de V, Permeation properties. In Booth Colin and Price Colin, editors, Compreh
Characterization, Reactions & Applications of Polymers, Vol 2: Polymer Properties, chapter 20,
20. Russ Thomas, Brenn Rüdiger, Geoghegan Mark, Equilibrium swelling of polystyrene netwo
36(2003)127-141.
21. Gundert F, Wolf B A, Polymer-solvent interaction parameters. In Polymer Handbook, (eds)
York), 3rd edn, (1989), pp VII/173–VII/182.
22. Errede L A, Polymer Swelling, 13: Correlation of Flory-Huggins interaction parameter, , wit
J Appl Polym Sci, 45(1992)619-631.
23. Habicht Jörg, Markus Schmidt, Rühe Jürgen, Johannsmann Diethelm, Swelling of thick po
Langmuir, 15(1999)2460-2465.
24. Biesalski M, Johannsmann D, Rühe J, Synthesis and swelling behavior of a weak polyacid b
25. Flory Paul J, Rehner John (Jr), Statistical mechanics of cross-linked polymer networks I: Ru
26. Flory Paul J, Rehner John (Jr), Statistical mechanics of cross-linked polymer networks II. Sw
27. Toomey R, Freidank D, Rühe J, Swelling behavior of thins urface-attached polymer networ
28. Campbell M, Sharp D N, Harrison M T, Denning R G, Turberfield A J, Fabrication of photo
lithography, *Nature*, 404(2000)53-56.
29. Simonov A N, Akhzar-Mehr O, Vdovin G, Light scanner based on viscoelastic stretchable g
30. Zhao Yue, Bai Shuying, Dumont Dany, Galstian Tigran V, Mechanically tunable diffraction
Advanced Materials, 14(2002)512-514.

31. Pelrine Ronald E, Kornbluh Roy D, Joseph Jose P, Electrostriction of polymer dielectrics wit
Sensors and Actuators A, 64(1998)77-85.

32. Mirfakhrai Tissaphern, Madden John D W, Baughman Ray H, Polymer artificial muscles, *M*

33. Aschwanden Manuel, Stemmer Andreas, Polymeric, electrically tunable diffraction grating
2612.

34. Aschwanden Manuel, Stemmer Andreas. Low voltage, highly tunable diffraction grating ba
Yoseph (ed), Proceedings of SPIE, Electroactive Polymer Actuators and Devices (EAPAD), volum

35. Aschwanden Manuel, Beck Markus, Stemmer Andreas, Diffractive transmission grating tun
Technol Lett, 19(2007)1090-1092.

36. Kollosche Matthias, Döring Sebastian, Stumpe Joachim, Kofod Guggi, Voltagec ontrolled c
gratings, *Opt Lett*, 36(2011)1389-1391.

37. Ghisleri C, Potenza M A C, Ravagnan L, Bellacicca A, Milani P, A simple scanning spectrom
grating, *Appl Phys Lett*, 104(2014)061910; doi.org/10.1063/1.4865427 38. Hohlfeld Dennis,
based on thermo-optic effect, *J Opt A: Pure and Appl Opt*, 6(2004)504-511.

39. Daleiden J, Rangelov V, Irmer S, Römer F, Strassner M, Prott C, Tarraf A, Hillmer H, Record
filter, *Electron Lett*, 38(2002)1270-1271.

40. Soda Haruhisa, Iga Kenichi, Kitahara Chiyuki, Suematsu Yasuharu, GaInAsP/InP surface em
18(1979)2329-2330.

41. Iga K, Ishikawa S, Ohkouchi S, Nishimura T, Room-temperature pulsed oscillation of GaAl/
Lett, 45(1984)348-350.

42. Kimura Mitsuteru, Okahara Kazuaki, Miyamoto Toshihiko, Tunable multilayer film distribu
1225.

43. Fink Yoel, Winn Joshua N, Fan Shanhui, Chen Chiping, Michel Jürgen, Joannopoulos John
omnidirectional reflector, *Science*, 282(1998)1679-1682.

44. Weber Michael F, Strover Carl A, Gilbert Larry R, Newitt Timothy J, Ouderkirk Andrew J, Ou
polymer mirrors, *Science*, 287(2000)2451-2456.

45. Strharsky Roger, Wheatley John, Polymer optical interference filters, *Opt Photon News*, 13(

46. Nolte Adam J, Rubner Michael F, Cohen Robert E, Creating effective refractive index gradie
Molecularly assembled rugate filters, *Langmuir*, 20(2004)3304-3310.

47. Sandrock Marie, Wiggins Michael, Shirk James S, Tai Huiwen, Ranade Aditya, Eric Baer, Hil
nanolayered photonic material, *Appl Phys Lett*, 84(2004)3621-3623.

48. Harada K, Munakata K, Itoh M, Yoshikawa N, Umegaki S, Yatagi T, Spatial filtering used pol
Electron, 32(2000)1351-1358.

49. Vogel V, Berroth M, Tunable liquid crystal Fabry–Perot filters, in: Integrated Optical Device
SPIE, 4944(2003)293-302.

50. Sio Luciano De, Tabiryan Nelson, Bunning Timothy J, POLICRYPS-based electrically switc
32702.

51. Wang G, Huang J P, Yu K W, Electrically tunable photonic crystals with nonlinear composit
doi.org/10.1063/1.2809389

52. Mönch Wolfgang, Dehnert Jan, Prucker Oswald, Rühe Jürgen, Zappe Hans, Tunable Bragg f
polymer swelling, *Appl Opt*, 45(2006)4284-4290.

53. Mönch W, Dehnert J, Jaufmann E, Zappe H, Flory-Huggins-swelling of polymer Bragg mirr
doi.org/10.1063/1.2358811

54. Kang Youngjong, Walish Joseph J, Gorishnyy Taras, Thomas Edwin L, Broadwavelength-ra
gels, *Nature Materials*, 6(2007)957-960.

55. Karaman Mustafa, Kooi Steven E, Gleason Karen K, Vapor deposition of hybrid organic-ino
reversibly tunable optical reflectance, *Chem Mater*, 20(2008)2262-2267.

56. Arregui Francisco J, Claus Richard O, Cooper Kristie L, Fernández-Valdivielso Carlos, Matía
assembled gratings, *J Lightwave Technol*, 19(2001)1932-1037.

57. Zhai Lei, Nolte Adam J, Cohen Robert E, Rubner Michael F, pH-gated porosity transitions
geometries and their applications as tunable bragg reflectors, *Macromolecules*, 37(2004)6113-61

58. John Sajeev, Florescu Marian, Photonic bandgap materials: towards an all-optical micro-tr
S120.

59. Busch Kurt, John Sajeev, Liquid-crystal photonic band-gap materials: The tunable electron

60. Leonard S W, Mondia J P, van Driel H M, oader O, John S, Tunable twodimensional photon
B, 61(2000)R2389-R2392.

61. Schuller Ch, Klopf F, Reithmaier J P, Kamp M, Forchel A, Tunable photonic crystals fabrica
infiltrated liquid crystals, *Appl Phys Lett*, 82(2003)2767-2769.

62. Kubo Shoichi, Gu Zhong-Ze, Takahashi Kazuyuki, Fujishima Akira, Segawa Hiroshi, Sato O
a liquid crystal-infiltrated inverse opal structure, *J Am Chem Soc*, 126(2004)8314-8319.

63. Shoichi Kubo, Zhong-Ze Gu, Kazuyuki Takahashi, Akira Fujishima, Hiroshi Segawa, and Os
crystal-infiltrated inverse opal structures using photo irradiation and/or an electric field, *Chemi*

64. Ozaki Masanori, Shimoda Yuki, Masahiro Kasano, Yoshino Katsumi, Electric field tuning of
inverse opal, *Advanced Materials*, 14(2002)514-518.

65. Escuti Michael J, Qi Jun, Crawford Gregory P, Two-dimensional tunable photonic crystal fo
Threshold behavoir and morphology, *Appl Phys Lett*, 83(2003)1331-1333.

66. Haurylau Mikhail, Weiss Sharon M, Fauchet Philippe M, Dynamically tunable 1d and 2d ph
applications, In Fauchet Philippe M, Braun Paul V (Eds), Tuning the Optical Response of Phot
49.

67. Weiss S M, Haurylau M, Fauchet P M, Tunable photonic bandgap structures for optical inte

68. Erickson David, Rockwood Troy, Emery Teresa, Scherer Axel, Psaltis Demetri, Nanofluidic t
31(2006)59-61.

69. Haakestad M W, Alkeskjold T T, Nielsen M D, Scolari L, Riishede J, Engan H E, Bjarklev A, El
liquid-crystal-filled photonic crystal fiber, *IEEE Photon Technol Lett*, 17(2005)819-821.

70. Kerbage C, Eggleton B J, Tunable microfluidic optical fiber gratings, *Appl Phys Lett*, 83(2003

71. Tian Huiping, Zi Jian. One-dimensional tunable photonic crystals by means of external ma

72. Aoki T, Kondo M, Ishii M, Sugama A, Tsukada M, Kurihara K, Kuwabara M, Preparation and
crystals using a sol-gel method, *J Europ Ceram Soc*, 25(2005)2917-2920.

73. Li Bo, Zhou Ji, Li Longtu, Wang Xing Jun, Liu Xiao Han, Zi Jian, Ferroelectric inverse opals
Phys Lett, 83(2003)4704-4706.

74. Chong H M H , Rue RM De La, Tuning of photonic crystal waveguide microcavity by therm
16(2004)1528-1530.

75. Escuti M J, Qi J, Crawford G P, Tunable face-centered-cubic photonic crystal formed in hol
Lett, 28(2003)522-524.

76. Rajic S, Corbeil J L, Datskos P G, Feasibility of tunable MEMS photonic crystal devices, *Ultr*

77. Park Wounjhang, Lee Jeong-Bong, Mechanically tunable photonic crystal structure, *Appl P*

78. Fudouzi Hiroshi, Sawada Tsutomu, Photonic rubber sheets with tunable color by elastic de
79. Arsenault André C, Clark Timothy J, Freymann Georg von, Cademartiri Ludovico, Sapienza
Wong Sean, Kitaev Vladimir, Manners Ian, Wang R Z, John Sajeev, Wiersma Diederik, Ozin Geo
fingerprinting to the control of photoluminescence in elastic photonic crystals, *Nature Materi*
80. Fudouzi Hiroshi, Xia Younan, Photonic papers and inks: Color writing with colorless mater
81. Foulger Stephen H, Jiang Ping, Ying Yurong, Lattam Amanda C, Smith Dennis W (Jr), Balla
13(2001)1898-1901,
82. Edrington Alexander C, Urbas Augustine M, DeRege Peter, Chen Cinti X, Swager Timothy M
Lewis J, Joannopoulos John D, Fink Yoel, Thomas Edwin L, Polymer-based photonic crystals, *A*
83. Xia Jiqiang, Ying Yurong, Foulger Stephen H, Electric-field-induced rejection wavelength tu
17(2005)2463-2467.
84. Kang Ji-Hwan, Moon Jun Hyuk, Lee Seung-Kon, Park Sung-Gyu, Jang Se Gyu, Yang Seung-M
by three dimensional holographic lithography, *Adv Mat*, 20(2008)3061-3065.
85. Arsenault André C, Míguez Hernán, Kitaev Vladimir, Ozin Geoffrey A, Manners Ian, A polyc
crystal with solvent and redox tunability: A step towards photonic ink (p-ink), *Adv Mat*, 15(2003
86. Arsenaul André C, Kitaev Vladimir, Manners Ian, Ozin Geoffrey A, Mihi Agustín,Míguez Her
with pressure tunability, *J Mater Chem*, 15(2005)133-138.
87. Shung Kenneth W.-K, Tsai Y C, Surface effects and band measurement in photonic crystals
88. Arsenault André C, Puzzo Daniel P, Manners Ian, Ozin Geoffrey A, Photoniccrystal full-colo
89. Pan G, Kesavamoorthy R, Asher S A, Optically nonlinear Bragg diffracting nanosecond opti
90. Xu X, Majetich S A, Asher S A, Mesoscopic monodisperse ferromagnetic colloids enable ma
Soc, 124(2002)13864-13868.
91. Holtz John H, Asher S A, Polymerized colloidal crystal hydrogel films as intelligent sensing
92. Holtz John H, Holtz Janet S W, Munro Calum H, Asher S A. Intelligent polymerized crystall
materials, *Anal Chem*, 70(1998)780-791.
93. Gu Zhong-Ze, Fujishima A, Sato O, Photochemically tunable colloidal crystals, *J Am Chem*
94. Gu Zhong-Ze,Iyoda T, Fujishima A, Sato O, Photoreversible regulation of optical stop band
95. Debord J D, Lyon L A, Thermoresponsive photonic crystals, *J Phys Chem B*, 104(2000)6327-
96. Lyon L A, Debord J D, Debord S B, Jones C D, McGrath J G, and Serpe M J, Microgel colloida
97. Valkama S, Kosonen H, Ruokolainen J, Haatainen T, Torkkeli M, Serimaa R, Ten Brinke G, I
temperature-induced large and reversible photonic-bandgap switching, *Nature Materials*, 3(20

Tunable optical submicron structures based on soft matter.pdf
Wolfgang Mönch

Asian Journal of Physics

Percolation threshold gold films on columnar coatings: charact

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Percolation of gold films of ~ 15 nm thickness was controlled to achieve the largest openings
nm-thick films of nanostructured porous and columnar SiO_2, TiO_2 and MgF_2 which were depo
film formation and ambient pressure. The gold films were tested for SERS performance using
self-assembled monolayer on gold. The phase retardation of these SERS substrates was up to
measured by Stokes polarimetry. The SERS intensity on gold percolation films can reach ~ 103
side excitation through the substrate has shown the presence of an additional SERS enhancer
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Keywords: 3D coatings, Raman sensors, surface enhanced Raman scattering

Total Refs: 15

1. Jayawardhana S, Rosa L, Juodkazis S, Stoddart P R, Additional enhancement of electric fiel
Fresnel mechanism, Sci Rep, 3(2013)2335; doi: 10.1038/srep02335.
2. Kabashin A V, Evans P, S. Pastkovsky S, W. Hendren W, Wurtz G A, Atkinson R, Pollard
metamaterials for biosensing, Nature Materials, 8(2009)867-871.
3. Nishijima Y, Hashimoto Y, Rosa L, Khurgin J B, Juodkazis S, Scaling rules of SERS intensity
4. Nishijima Y, Khurgin J B, Rosa L, Fujiwara H, Juodkazis S, Randomization of gold nano-bri
Opt Express, 21(2013)13502-13514.
5. Sharma A K, Jha R, Gupta B D, Fiber-optic sensors based on surface plasmon resonar
7(2007)1118-1129.
6. Stoddart P R, White D J, Optical fibre SERS sensors, Anal Bioanal Chem, 394(2009)1761-177
7. Lakhtakia A, Messier R, Sculptured thin films: Nanoengineered Morphology and Optics, (S
8. Messier R, Gehrke T, Frankel C, Venugopal V C, Otano W, Lakhtakia A, Engineered sculptu
15(1997)2148-2152.
9. Lee G J, Lee Y P, Jung B Y, Jung S G, Hwangbo C K, Kim J H, Yoon C K, Microstructural and
the
optical percolation threshold, J Korean Phys Soc, 51(2007)1555-1559.
10. Berry H G, Gabrielse G, Livingston A E, Measurement of the Stokes parameters of light, Ap
11. Buividas R, Stoddart P R, Juodkazis S, Laser fabricated ripple substrates for surface-
524(2012)L5-L10.
12. Balcytis A, Ryu M, Seniutinas G, Juodkazyte J, Cowie B C C, Stoddart P R, Morikawa J,
scattering
and infrared properties, Nanoscale, 7(2015)18299-18304.
13. Dinda S, Suresha V, Thoniyot P, Balcytis A, Juodkazis S, Krishnamoorthy S, Engineering 3I
performance in spectroscopic sensing, ACS Appl Mater Interf, 7(2015)27661-27666.
14. Jayawardhana S, Rosa L, Buividas R, Stoddart P R, Juodkazis S, Light enhancement in surfa
Photonic Sensors, 2(2012)283-288.
15. Grigorenko A N, Nikitin P I, Kabashin A V, Phase jumps and interferometric surface plasmo
3919.

Percolation threshold gold films on columnar coatings characterisation for SERS applic
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Asian Journal of Physics

Variability of gratings manufactured by interfere

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Diffraction gratings are utilized in many high-end optical systems, including high-resolution
extreme ultraviolet lithography, and high-power ultrashort laser pulse shaping. The gratin
substrate geometry, grating profiles, diffraction efficiency, and scattered light level. In this
versatile and well-adapted fabrication technology, even for today's most demanding specifica
geometry, exposure setup, exposure, development, etching, and scattering measurement are di
demonstrated by realizing spectroscopic gratings with reduced scattered light, a grazing-inci
efficiency of up to 32%, and highly dispersive pulse compression gratings reaching up to 96% ef

Keywords: Diffraction gratings, Ultraviolet lithography, Diffraction efficiency

Total Refs: 40

Asian Journal of Physics

Efficiency-achromatized reflective dispersion grating by a d
Theoretical conditions for optimal materi

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[3] Fraunhofer Institute for Applied Optics and Precision Engineerin

Blazed gratings are key components both for imaging and for spectrally analyzing optical sy
towards wavelength variations. Double-blazed gratings overcome this disadvantage but have
geometries. Here we present a systematical theoretical analysis of the diffraction efficiency of d
find appropriate conditions for a systematical material selection to achieve efficiency-ach
dispersion parameters such as the Abbe's number and relative partial dispersion of the mate
shallow as possible. Therefore, appropriate material combinations which are suitable for s

Key Words: Blazed gratings, Diffraction efficiency, Abbe's number

Total Refs: 13

1. Ebstein S M, Nearly index-matched optics for aspherical, diffractive, and achromatic-pha
2. Arieli Y, Noach S, Ozeri S, Eisenberg N, Design of diffractive optical elements for multiple
3. Arieli Y, Ozeri S, Eisenberg T, Noach S, Design of diffractive optical elements for wide spec

4. Herzig H P, Schilling A, Optical Systems – Design Using Microoptics in Encyclopedia of C
Dekker), 2003,pp 1830-1842
5. Nakai T, Ogawa H, Research on multi-layer diffractive optical elements and their applicati
Micro-Optics, (Technical Digest), 5-7 (2002).
6. Brunner R; Transferring diffractive optics from research to commercial applications: Part I
Adv Opt Techn, 2(2013)351-359.
7. http://www.imaging-resource.com/news/2015/01/19/canon-400mm-f-4-do-ii-lens-reviev
8. http://www.imaging-resource.com/news/2015/10/05/nikon-300mm-f-4-pf-vr-lens-rev
visit 01/30/2016
9. Sandfuchs O, Schwanke Ch, Burkhardt M, Wyrowski F, R. Brunner R, Modeling adapt
structures, J Eur Opt Soc, 6(2011)1-10 .
10. O'Shea D C, Suleski T J, Kathman A D, Prather D W, Diffractive Optics – Design, Fabricati
11. Brunner R "8.1 Diffractive Optical Elements" in Springer Handbook of Lasers and Op
(2012).
12. Catalog of "Optical Glasses", Advanced Optics, SCHOTT AG, 2007 (see http://www.schot
13. Bäumer S, "Handbook of Plastic Optics", (Wiley-VCH), 2010

Efficiency-achromatized reflective dispersion grating by a double-blaze configuration: T
selection.pdf
O Sandfuchs and R Brunner

Asian Journal of Physics

Micro-Optics for Biomimetic Vision Sy

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Mobile phone cameras are a flagship feature of a flagship device. Customers will always opt fo
law of optics and the related space bandwidth product (SBP) describe the difficulties to furthe
camera size and thickness. The demand for higher and higher image quality of mobile phone
sensor systems. When a vision system needs to be very small, very fast orhas to operate wit
teacher. Nature has struggled with the scaling law of optics since more than 500 million y
strategies for miniaturization of mobile phone vision systems.

Keywords: Mobile phone camera, Biomimetic strategies, Bandwidth
Total Refs: 22

1. Lohmann Adolf W., 'Scaling laws for lens systems, Appl Opt, 28(1989)4996 -4998.
2. Voelkel Reinhard, Zoberbier Ralph, 'Inside Wafer-Level Cameras, Semicond Intern, Februa
3. Ozaktas Haldun M, Urey Hakan, Lohmann Adolf W., 'Scaling of diffractive and refractive len
App Opt, 33(1994)3782 -3789.
4. Hofmann C, Die optische Abbildung', Akademische Verlagsgesellschaft Geest &Portig K.-G.
5. Voelkel Reinhard, 'Natural optical design concepts for highly miniaturized camera systems
Systems II, 548 (August 27, 1999); doi:10.1117/12.360049.

6. Snyder A. W., 'Acuity of compound eyes: physical limitations and design', Journ. of Comp.
7. Franceschini N., Riehle A., Le Nestour A., 'Directionally selective motion detection by insec
Stavenga, R. Hardie, Springer Verlag Berlin, 360-390 (1989).
8. Gale M. T., Lehmann H. W., Widmer R. W., 'Color diffractive subtractive filter master record
relief patterns on the surface of a substrate', US Patent 4155627, (1977).
9. Nikon Nano Crystal Coat, http://nikon.com/about/technology/life/imaging/nano/index.h
10. Clapham P.B., Hutley M.C., 'Reduction of lens reflextion by the 'moth eye' principle', Natu
doi:10.1038/244281a0
11. Rudmann H, Rossi M; 'Design and fabrication technologies for ultraviolet replicated micro-
12. Schmitt Holger et. al., 'Full wafer microlens replication by UV imprint lithography, Microel
13. Voelkel Reinhard, Duparre Jacques, Wippermann Frank, Dannberg Peter, Braeuer Andreas,
Technology trends of microlens imprint lithography and wafer level cameras (WLC)', 14th Micr
Brussels, Belgium Techn. Dig. p. 312–315 (2008).
14. Iga K., Kokubun Y., Oikawa M., 'Fundamentals of Microoptics: Distributed-Index, Microlen
ISBN-10: 0123703603 (1984).
15. Voelkel Reinhard, Herzig Hans Peter, Nussbaum Philippe, Singer Wolfgang, Weible Kennet
lithography: a new fabrication method for very large displays', Asia Display'95, pp. 713-716, (199
16. EU-IST-2001-35366, Project WALORI, 'WAfer Level Optic solution foR compact CMOS Imag
LETI, ATMEL, IMT Neuchâtel, Fresnel Optics, SUSS MicroOptics.
17. Markus Rossi, Ville Kettunen, Heptagon Oy, Espoo (SF), 'Opto-electronic module and devi
2013.
18. Reinhard Voelkel, Stefan Wallstab, 'Flat imageacquisitionsystem', Offenlegungsschrift DE 1
19. Snapman by Herman Scherling, EP 0906587 B1, (1996)
20. Frank Wippermann, Andreas Brückner, 'Ultra-thin wafer-level cameras', SPIE Newsroom, (
21. Brückner A, Leitel R, Oberdörster A, Dannberg P, Wippermann F, Bräuer A, Multi-aperture o
MEMS MOEMS. 0001; 10(4):043010-043010-10 doi:0.1117/1.3659144 (20111).
22. KazuichiroItonaga, Sony Corporation, Tokyo (J), 'Method of manufacturing solid-state ima
electronic apparatus', US 2012/0217606 A1 (2012).

Asian Journal of Physics

Silicon Photonics Technology : Ten Years of Research at II

B K Das, N Das Gupta, S Chandran, S Kurudi, P Sah, R Nandi, Rames
S M Sundaram, P Sakthivel, Sidharth R, R Joshi, H Sasikum
S Krubhakar, G R Bhatt, J P George, R K Navalakhe, Narendran R,
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The integrated optoelectronics research group at IIT Madras has been active since 2007 wi
excellence for silicon photonics research. The core research theme involves novel designs, C
and subsequent experimental demonstrations leading towards cost-effective, energy-efficien
various applications. As of now, various prototype devices like power splitters, ITU channel in

shifters/modulators, ring resonators, DBR filters etc., have been demonstrated by exploiting c
recently established nano-fabrication facilities at IIT Madras. Their design principle, process
described in the present article.
Keywords: Optoelectronics, p-i-n phase shifters/modulators, Ring resonators, DBR filters.
Total Refs: 42

1. Goodman J W, Leonberger F I, Kung S Y, Athale R A, Optical interconnections for VLSI sys
2. Miller D A B, Optical interconnects to silicon, IEEE JSTQE, 6(2000)1312-1317.
3. Young I A, Mohammed E, Liao J T S, Kern A M, Palermo S, Block B A, Reshotko M R, computing, IEEE J Solid State Circuits, 45(2010)235-248.
4. Koehl S, Liu A, Paniccia M, Integrated Silicon Photonics: Harnessing the data explosion, O
5. Beausoleil R G, Large-scale integrated photonics for high-performance 10.1145/1970406.1970408
6. Sun C, Wade M T, Lee Y, Orcutt J S, Alloatti L, Georgas M S, Waterman A S, Shainline J M, Atabaki A H, Cook H M, Ou A J, Leu J C, Chen Yu-Hsin, Ram R J, Popovi M A, Stojanovi V directly using light, Nature, 528(2015)534-538.
7. Bowers J, Liang D, Fang A, Park H, Jones R, Paniccia M, Hybrid Silicon lasers: the final News, 21(2010)28-33.
8. Michel J, Liu J, Kimerling L C, High-performance Ge-on-Si photodetector, Nature Photon
9. Thomson D J, Reed G T, Silicon modulators based on free carrier concentration variati 439-478, 2013 (CRC Press, Taylor & Francis Group).
10. Park S, Yamada K, Tscuchizawa T, Watanabe T, Shinojima H, Nishi H, Kou R, Itabas silicon p-i-n variable optical attenuators fabricated on submicrometer rib waveguides, Opt Expr
11. Morichetti F, Melloni A, Ferrari C, Martinelli M, Error-free continuously-tunable delay at Express, 16(2008)8395-8405.
12. Sun P, Reano R M, Sub-milliwatt thermo-optic switches usingfree-standing si 18(2010)8406-8411.
13. Suzuki K, Tanizawa K, Matsukawa T, Cong G, Kim S.-H., Suda S, Ohno M, Chiba T, Tad M, Igarashi Y, Masahara M, Namiki S, Kawashima H, Ultra-compact 8× 8 strictly- non-blockin 3894.
14. Dong P, Qian W, Liang H, Shafiiha R, Feng D, Li G, Cunningham J E, Krishnamoorthy resonators with ultralow tuning power, Opt Express, 18(2010)20298-20304.
15. Leuthold J, Koos C, Freude W, Nonlinear silicon photonics, Nature Photonics, 4(2010)53
16. Navalakhe R K, Gupta Nandita Das, Das B K, Fabrication and Characterization of Straigh Silicon-on-Insulator Platform, App Opt, 48(2009)G125-G130.
17. George J P, Dasgupta N, Das B K, Compact integrated optical directional coupler with lar Proc SPIE, 7719(2010)77191X-77191X.
18. Bhatt G R, Das B K, Demonstration of ITU channel interleaver in SOI with large cross sec Proc SPIE, 8069(2011)806904-806904.
19. Krubhakar I S, Narendran R, Das B K, Design and fabrication of integrated optical 1x8 po single-mode waveguides, Proc SPIE, 8173(2011)81730C;doi:1117/12.898475
20. Bhatt G R, Sharma R, Karthik U, Das B K, Dispersion-Free SOI Interleaver for DWDM Ap
21. Bhatt G R, Das B K, Improvement of polarization extinction in silicon waveguide devices
22. Chandran S, Das B K, Tapering and Size Reduction of Single-mode Silicon Wavegui

Communication Conference, Bexco, Busan Korea, July 02-06, 2012.
23. Sasikumar H, Venkitesh D, Das B K, Highly efficient DBR in silicon waveguides with elev
San Francisco, CA, USA, 2-7 February 2013 (Paper 8629-16)
24. Karthik U, Das B K, Polarization-independent and dispersion-free integrated optical
Photonics West 2013, San Francisco, CA, USA, 2-7 February 2013 (Paper 8629-35).
25. Sakthivel P, Dasgupta N, Das B K, Simulation and experimental studies of diffusion
Photonics West 2013, San Francisco, CA, USA, 2-7 February 2013 (Paper 8629-33).
26. Joshi R, B K, Gupta N D, Design of 2D Photonic crystals for integrated optical slow light a
27. Chandran S, Kaushal S, Das B K, Monolithic integration of micron to submicron wavegu
(Invited Talk), SPIE Photonics West 2014, San Francisco, CA, USA, 1-6 Feb 2014.
28. Ravindran S, Das B K, Design and fabrication of 8-channel AWGs with 2-■m-SOI for c
Francisco, CA, USA, 1-6 February 2014.
29. Ravindran S, Das B K, Modeling and Phase Error Analysis of AWG in SOI using
Conference on Fibre Optics and Photonics, Kharagpur, India , 13-16 December 2014 (Paper- T3A
30. Kaushal S, Das B K, Design of maximally flat delay lines using apodized CROW struct
Optics and Photonics, Kharagpur, India , 13-16 December 2014 (Paper- 4B.3).
31. Sidharth R, Das B K, Semi-analytical model of arrayed waveguide grating in SO
54(2015)2158-2163.
32. Chandran S, Das B K , Surface trimming of silicon photonics devices using contro
Nanostructures – Fundamentals and Applications, 15(2015)32-40.
33. Chandran S, Sundaram S M, Das B K, Method and apparatus for modifying dimensions c
34. Celler G K, Cristoloveanu Sorin, Frontiers of silicon-on-insulator, J Appl Phys, 93(2003)49
35. Hsu S.-H, Tseng S.-C, You H.-Z, Birefringence characterization on soi waveguide using o
International Conference on Group IV Photonics, 2010.
36. Khilo A, Popovi´c M A, Araghchini M, Kärtner F X, Efficient planar fiber-to-chip couple
Ten Years of Research at IIT Madras 955 adiabatic evolution, Opt Express, 18(2010)15790-15806.
37. Asghari M, Krishnamoorthy A V, Silicon photonics: Energy-efficient communication, Na
38. Bogaerts W, Heyn P De, Vaerenbergh T Van, Vos K De, Selvaraja S Kumar, Claes T, Dumo
Silicon microringresonators, Laser & Phot Rev, 6(2012)47-73.
39. Xu Dan-Xia, Densmore A, Waldron P, Lapointe J, Post E, Delâge A, Janz S, Cheben P, Jens
photonic wire ringresonators using MMI couplers, Opt Express, 15(2007)3149-3155.
40. Thomson D J, Hu Y, Reed G T, Fedeli Jean-Marc,Low Loss MMI Couplers for High Perfor
Letters, 22(2010)1485-1487.
41. Pathak S, Vanslembrouck M, Dumon P, Thourhout D V, Bogaerts W, Optimized Silico
MMI Aperture, J Lightwave Tech, 31(2013)87-93.
42. Soldano L B, Pennings E C M, Optical multi-mode interference devices based on self-ima
Techy, 13(1995)615-627.

Variety of gratings manufactured by interferen

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Diffraction gratings are utilized in many high-end optical systems, including high-resolution
extreme ultraviolet lithography, and high-power ultrashort laser pulse shaping. The gratin
substrate geometry, grating profiles, diffraction efficiency, and scattered light level. In this
versatile and well-adapted fabrication technology, even for today's most demanding specifica
geometry, exposure setup, exposure, development, etching, and scattering measurement are di
demonstrated by realizing spectroscopic gratings with reduced scattered light, a grazing-inci
efficiency of up to 32%, and highly dispersive pulse compression gratings reaching up to 96% ef

Keywords: Diffraction gratings, Ultraviolet lithography, Diffraction efficiency

References

1. Voronov D L, Anderson E H, Cambie R, Gawlitza P, Goray L I, Gullikson E M, Padmore H A,
gratings for EUV and soft x-rays with very high efficiency and resolving power, . *Phys: Conf Ser*, 4
6596/425/15/152006
2. Nakano N, Kuroda H, Kita T, Harada T, Development of a flat-field grazing-incidence XUV s
spectroscopy, *Appl Opt*, 23(1984)2386-2392.
3. Lin H, Li L, Fabrication of extreme-ultraviolet blazed gratings by use of direct argon-oxygen
mask, *Appl Opt*, 47(2008)6212-6218.
4. Ricci L, Weidemüller M, Esslinger T, Hemmerich A, Zimmermann C, Vuletic V, Hänsch T W
for atomic physics, *Opt Commun*, 117(1995)541-549
5. Struckmeier J, Euteneuer A, Smarsly B, Breede M, M. Born, Hofmann M, Hildebrand L, Sach
diode, *Opt Lett*, 24(1999)1573-1574.
6. Daneu V, Sanchez A, Fan T Y, Choi H K, Turner G W, Cook C C, Spectral beam combining o
cavity, *Opt Lett*, 25(2000)405-407.
7. Weiner A M, Heritage J P, Kirschner E M, High-resolution femtosecond pulse shaping, *J Opt*
8. Rowland H A, LXI. Preliminary notice of the results accomplished in the manufacture and t
5(1882)469-474.
9. Cordelle J, Flamand J, Pieuchard G, Labeyrie A, Aberration-corrected concave gratings made
Techniques,1(1969)117-124.
10. Harada T, Kita T, Mechanically ruled aberration-corrected concave gratings, *Appl Opt*, 19(1
11. Bittner R F, Concave Holographic Gratings Used As Monochromators, *Proc SPIE* 0655, Inte
Symposium/Innsbruck,10.1117/12.938430(1986).
12. Dobschal H J, Kröplin P, Reichel W, Rudolf K, Konkave Reflexionsbeugungsgitter mit abbild
Zeiss JENA, *Jenaer Rundschau*, 4(1989)196-197.
13. Glaser T, High-end spectroscopic diffraction gratings: design and manufacturing, *Adv Opt T*
14. Popov E, Bozkov B, Sabeva M, Maystre D, Blazed holographic grating efficiency-numerical
117(1995)413-416.

15. Bittner R, Holographische Gitter als Dioden-Zeilen-Spektrographen. *Optik*, 64(1983)185-19
16. Levinson Harry J, Principles of lithography, (SPIE, Bellingham, Washington 98227-0010 USA
17. Schlemmer H H, Machler M, Diode array spectrometer: an optimised design, *J Phys E: Sci I*
18. Neviere M, Petit R, Electromagnetic theory of gratings, (Springer-Verlag,Tiergartenstrasse 1
19. Nevière M, Popov E, Light propagation in periodic media: differential theory and design, (M
2002.
20. Popov E, Gratings: theory and numeric applications, (Popov, Institut Fresnel, Université d'
Marseille Cedex 20), 2014.
21. Sandfuchs O W, Schwanke C, Burkhardt M, Wyrowski F, Gatto A, Brunner R, Modelling ada
grating structures, *JEOS*, 6 (2011)11006-1-1106-10; doi:10.2971/jeos.2011.11006
22. Loewen E G, Popov E, Diffraction gratings and applications, (Marcel Dekker, 270 Madison A
23. Nicodemus F E, Richmond J C, Hsia J J, Ginsberg I W, Limperis T, Geometrical consideratio
Department of Commerce, National Bureau of Standards Washington, D. C, 1977.
24. Sharpe M R, Irish D, Stray light in diffraction grating monochromators, *Opt Acta*, 25(1978)8
25. Stover J C, Optical scattering: measurement and analysis, Vol 2, (SPIE, Bellingham, Washin
26. Neviere M, Flamand J, Electromagnetic theory as it applies to X-ray and XUV gratings, *Nucl*
27. Weiner A, Ultrafast Optics, Vol 72, (John Wiley & Sons), 2011.
28. Clausnitzer T, Kämpfe T, Kley E B, Tünnermann A, Peschel U, Tishchenko A V, Parriaux O,
diffraction in deep dielectric rectangular transmission gratings, *Opt Express*, 13(2005)10448-1045
29. Clausnitzer T, Limpert J, Zöllner K, Zellmer H, Fuchs H.-J, Kley E.-B, Tünnermann A, Jupé I
in fused silica for chirped-pulse amplification systems, *Appl Opt*, 42(2003)6934-6938.
30. Stuerzebecher L, Fuchs F, Harzendorf T, Zeitner U D, Pulse compression grating fabricatio
Lett, 39(2014)1042-1045.
31. Clausnitzer T, Kämpfe T, Kley E.-B, Tünnermann A, Tishchenko A.-V, Parriaux O, Highly-d
diffraction efficiency, *Opt Express*, 16(2008)5577-5584.
32. Nagashima K, Kosuge A, Ochi Y, Tanaka M, Improvement of diffraction efficiency of dielect
coatings, *Opt Express*, 21(2013)18640-18645.
33. Perry M D, Shannon C, Shults E, Boyd R D, Britten J A, Decker D, Shore B W, High-efficienc
20(1995)940-942.
34. Shore B W, Perry M D, Britten J A, Boyd R D, Feit M D, Nguyen H T, Chow R, Loomis G E, Li
reflection gratings, *J Opt Soc Am A*, 14(1997)1124-1136.
35. Hehl K, Bischoff J, Mohaupt U, Palme M, Schnabel B, Wenke L, Bödefeld R, Theobald W, W
dielectric reflection gratings: design, fabrication, and analysis, *Appl Opt*, 38(1999)6257-6271.
36. Rumpel M, Moeller M, Moormann C, Graf T, Ahmed M A, Broadband pulse compression g
Opt Lett, 39(2014)323-326.
37. Neauport J, Bonod N, Hocquet S, Palmier S, Dupuy G, Mixed metal dielectric gratings for p
23783
38. Flury M, Tishchenko A V, Parriaux O, The leaky mode resonance condition ensures 100% di
gratings, *J Lightwave Technol*, 25(2007)1870-1878.
39. Laskin A, Williams G, McWilliam R, Laskin V, Applying field mapping refractive beam shap
8281, Practical Holography XXVI: Materials and Applications, 82810K (2012).
40. Burkhardt M, Steiner R, Gatto A, Sinzinger S, Interferenzlithografie mit gesteuerter Belichtu

Heteronuclear Ir (III)-Ln (III) luminescent complexes: small-molecule probes for dual modal imaging and oxygen sensing, the phenomenon of cultural order, within the framework of today's views, gives tourist intelligence, further calculations will leave students as a simple homework.
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