9. REFERENCES

[1] N. Engheta, R. W. Ziolkowski, “Metamaterials: physics and engineering explorations”, *John Wiley & Sons*, 2006.

[2] J .C. Bose, “On the rotation of plane of polarization of electric waves by a twisted structure”, *Proceedings Roy. Society*, Vol. 63, pp.146–152, 1898.

[3] I. V. Lindell, A. H. Sihvola, J. Kurkijarvi, and K. F. Lindman, “The last hertzian, and a harbinger of electromagnetic chirality,” *IEEE Antenna Propagation Magazine*, Vol. 34, pp. 24–30, 1992.

[4] W. E. Kock, “Metallic delay lenses,” B. Sys. Tech. J., Vol. 27, pp. 58–82, 1948.

[5] V. G. Veselago, P. N. Labedev, “The electrodynamics of substances with simultaneously negative values of ε and μ,” *Soviet Physics Uspekhi,* Vol. 10, No. 4, pp. 509-514, 1968.

[6] J. B. Pendry, A. J. Holden, D. J. Robbins, and W.J. Stewart, “Magnetism from Conductors and Enhanced Nonlinear Phenomena,” *IEEE Transactions on Microwave Theory and Techniques*, Vol. 47, No. 11, pp. 2075-2084, 1999.

[7] D. R. Smith, W. J. Padilla, D. C. Vier, S. C. Nemat-Nasser and S. Schultz, “Composite medium with simultaneously negative permeability and permittivity,” *Physical Review Letters*, Vol. 84, No. 18, 4184–4187, 2000.

[8] M. Skolnik, RADAR handbook, 2nd ed., Tata McGraw Hill, pp. 11.1–11.30, 1990.

[9] A. Sundsmo, “Microwave absorbers: Reducing cavity resonances,” *Compliance Engineering Magazine*, pp. 2-5, June, 2006.

[10] P. Del Prete, “Reducing cavity resonance in wireless applications,” In RF Globalnet, May 2007.

[11] S. Enoch, G. Tayeb, and P. Vincent, “A metamaterial for directive emission,” *Physical Review Letters*, Vol. 89, pp. 3901–3904, 2002.

[12] K. Alici and E. Ozbay, “Radiation properties of a split ring resonator and monopole composites”, Phys Status Solidi B, Vol. 244, pp.1192–1196, 2007.

[13] F. Costa, S. Genovesi, and A. Monorchio, “A chipless RFID based on multi-resonant high-impedance surfaces,” *IEEE Transactions on Microwave Theory and Techniques,* Vol. 61, No. 1, pp. 146–153, 2013.

[14] P. Rufangura, “Wide-Band Perfect Metamaterial Absorber for Solar Cell Applications,” M.Sc. Disstertation, Middle East Technical University, Northern Cyprus Campus, August, 2015.

[15] D. Schurig, J. J. Mock, B. J. Justice, S. A. Cummer, J. B. Pendry, A. F. Starr, and D. R. Smith, “Metamaterial electromagnetic cloak at microwave frequencies,” *Science*, Vol. 314, pp. 977–980, 2006.

[16] S. A. Cummer, B. I. Popa, D. Schurig, D. R. Smith, and J. B. Pendry, “Full wave simulations of electromagnetic cloaking structures,” *Physical Review Letter*s , Vol. 74, Issue 3, pp. 036621, 2006.

[17] H. T. Chen, W. J. Padilla, M. J. Cich, A. K. Azad, R. D. Averitt, and A. J. Taylor, “A metamaterial solid state terahertz phase modulator,” *Nature Photon*., Vol. 3, pp. 148–151, 2009.

[18] Y. C. Chang, C. M. Wang, M. N. Abbas, M. H. Shih, and D. P. Tsai, “T-shaped plasmonic array as a narrow band thermal emitter or biosensor," *Optics Express*, Vol. 17, No. 16, pp. 13526 – 13531,2009.

[19] S. Yagitani, K. Katsuda, M. Nojima, Y. Yoshimura, and H. Sugiura, “Imaging radio-frequency power distributions by an EBG absorber,” *IEICE Transactions Communications.*, Vol. E94-B, No. 8, pp. 2306–2315.

[20] T. Maier and H. Bruckl, “Wavelength-tunable microbolometers with metamaterial absorbers,” *Optics Letters*, Vol. 34, No. 19, pp. 3012, 2009.

[21] S. A. Kuznetsov, A. G. Paulish, A. V. Gelfand, P. A. Lazorskiy, and V. N. Fedorinin, “Bolometric THz-to-IR converter for terahertz imaging,” *Applied Physics Letters*, Vol. 99, pp. 023501, 2011.

[22] N. I. Landy , S. Sajuyigbe , J. J. Mock , D. R. Smith , W. J. Padilla , “A Perfect Metamaterial Absorber”, *Physical Review Letters*, Vol. 100, pp.207402, 2008.

[23] W. W. Salisbury, “ Absorbant body for electromagnetic waves,” *US Patent*, 2599944, filed 11 May, 1943, granted June 10, 1952.

[24] G. T. Ruck , D. E. Barrick , W. D. Stuart , Radar Cross Section Handbook, Vol. 2, Plenum , New York 1970.

[25] B. A. Munk, “Frequency Selective Surfaces Theory and Design”, John Wiley, 2000.

[26] M.C. Dimri, S.C. Kashyap, D.C. Dube,“Complex permittivity and permeability of Co_2U ($Ba_4Co_2Fe_36O_60$) hexaferrite bulk and composite thick films at radio and microwave frequencies”, *IEEE Transactions on Magnetics,* Vol. 42, No. 11, pp: 3635 – 3640, 2006.

[27] Andrey N. Lagarkov, Konstantin N. Rozanov, “High-frequency behavior of magnetic composites”, *Journal of Magnetism and Magnetic Materials*, Vol. 321, pp. 2082–2092, 2009.

[28] F. Billotti, L. Nucci, and L. Vegni, “An SRR-based microwave absorber”, *Microwave and Optical Technology Letters,* Vol. 48, pp: 2171-2175, 2006.

[29] J. B. Pendry, A. J. Holden, W. J. Stewart, and I. Youngs, “Extremely low frequency plasmons in metallic mesostructures ,”*Physical Review Letters,* Vol. 76, No. 25, pp: 4773-4776, 1996.

[30] J. B. Pendry, A. J. Holden, D. J. Robbins and W. J. Stewart, “Low frequency plasmons in thin wire structures”, *Journal of Physics: Condensed Matter*, Vol. 10, No. 22, pp: 4785–4809, 1998.

[31] Y. Liua and X. Zhang, “Metamaterials: a new frontier of science and technology”, Chemical Society Reviews, Vol. 40, pp. 2494–2507, 2011.

[32] R. A. Shelby, D. R. Smith, and S. Schultz, “Experimental verification of a negative index of refraction”, *Science*, Vol. 292, pp.77-79, 2001.

[33] W. J. Padilla, D. N. Basov and D. R. Smith, “Negative refractive index metamaterials”, *Materialstoday*, Vol. 9, pp. 28-35, 2006.

[34] A. Kazemzadeh and A. Karlsson, “Capacitive circuit method for fast and efficient design of wideband radar absorber,” *IEEE Transactions on Antennas and Propagation*, Vol. 57, No. 8, pp. 2307–2314, 2009.

[35] F. Costa, S. Genovesi, and A. Monorchio, “A frequency selective absorbing ground plane for low-RCS microstrip antenna arrays,” *Progress In Electromagnetics Research*, Vol. 126, pp. 317–332, 2012.

[36] F. Costa and A. Monorchio, “A frequency selective radome with wideband absorbing properties,” *IEEE Transactions on Antennas Propagation*, Vol. 60, No. 6, pp. 2740–2747, 2012.

[37] E. Rephaeli and S. Fan, “Absorber and emitter for solar thermo photovoltaic systems to achieve efficiency exceeding the shockley-queisser limit,” *Optics Express*, Vol. 17, pp. 15145–15159, 2009.

[38] X. Liu, T. Tyler, T. Starr, A. F. Starr, N. M. Jokerst, and W. J. Padilla, “Taming the blackbody with infrared metamaterials as selective thermal emitters,” *Physical Review Letters*, Vol. 107, No. 4, pp.045901, 2011.

[39] J. Greffet, “Controlled incandescence,” *Nature*, Vol. 478, pp. 191, 2011.

[40] B. Chambers, and A. Tennant, Active Dallenbach radar absorber,” *IEEE International Symposium on Antennas and Propagation*, Albuquerque, New Mexico,USA, pp. 381-384,9–14 July, 2006.

[41] E. Popov , D. Maystre , R. C. McPhedran , M. Nevière , M. C. Hutley and G.H. Derrick, “Total absorption of unpolarized light by crossed gratings,” *Optics Express*, Vol. 16 , pp. 6146, 2008 .

[42] D. Sjoberg, “Analysis of wave propagation in stratified structures using circuit analogs, with application to electromagnetic absorbers,” *European Journal of Physics*, Vol. 29, pp. 721–734, 2008.

[43] D. Sievenpiper, L. Zhang, R. F. J. Broas, N. G. Alexopolous, and E. Yablonovitch, “High-impedance electromagnetic surfaces with a forbidden frequency band,” *IEEE Transactions on Microwave Theory Techniques*, Vol. 47, No. 11, pp. 2059–2074,1999.

[44] Q. Gao, Y. Yin, D. B. Yan, and N. C. Yuan, “A novel radar-absorbing material based on EBG structure,” *Microwave and Optical Technology Letters*, Vol. 47, No. 3, pp. 228–230,2005.

[45] H. Mosallaei and K. Sarabandi, “A one-layer ultra-thin meta-surface absorber,” *IEEE International Symposium on Antennas and Propagation*, Washington, DC, USA, Jul. 2005.

[46] S. Simms and V. Fusco, “Tunable thin radar absorber using artificial magnetic ground plane with variable backplane,” *Electronic Letters*, Vol. 42, No. 21, pp. pp.1197–1198, 2006.

[47] C. Mias and J. H. Yap, “A varactor-tunable high-impedance surface with a resistive-lumped-element biasing grid,” *IEEE Transactions on Antennas and Propagation*, Vol. 55, No. 7, pp. 1955–1962, 2007.

[48] A. Noor, Z. Hu, H. H. Ouslimani, and A. Priou, “Wideband thin resistive metamaterial radar absorbing screen,” IEEE *International Symposium on Antennas and Propagation*, pp. 1–5, 2009.

[49] B. A. Munk , Frequency Selective Surfaces , John Wiley & Sons ,New York 2000 .

[50] W. H. Emerson , “Electromagnetic wave absorbers and anechoic chambers through the years," *IEEE Transactions on Antennas and Propagation*, AP-21, No.4 , pp. 484–490, 1973.

[51] K. Chen, B. Zhu, N. Jia, B. Sima, J. Zhao, Y. Feng, “Ultrathin microwave absorber in wireless communication band made of swiss roll metamaterial structure,” *Proceedings* of *IEEE International Wireless Symposium*, pp.1-4, March, 2014.

[52] N. Engheta, "Thin absorbing screens using metamaterial surfaces", *IEEE Antennas and Propagation Society International Symposium*, Vol. 2, pp. 392-395, 2002.

[53] H. Tao , N. I. Landy , C. M. Bingham , X. Zhang , R. D. Averitt , W. J. Padilla, " A metamaterial absorber for the terahertz regime: Design, fabrication and characterization*,"Optics Express*, Vol. 16 , pp. 7181–7188, 2008.

[54] Y. Avitzour , Y. A. Urzhumov, and G. Shvets , "Wide-angle infrared absorber based on a negative- index plasmonic metamaterial," *Physical Review B* ,Vol. 79 ,Issue 4, pp. 045131, 2009.

[55] K. Aydin , V. E. Ferry , R. M. Briggs , H. A. Atwater ," Broadband polarization-independent resonant light absorption using ultrathin plasmonic super absorbers," *Nature Communications*, Vol. 2 , pp. 517, 2011.

[56] R. H. Ritchie, "Plasma Losses by Fast Electrons in Thin Films," *Physical Review*, Vol. 106, Issue 5, pp. 874–881, 1957.

[57] C. M. Watts , X. Liu , and W. J. Padilla, "Metamaterial Electromagnetic Wave Absorbers", *Advanced Optical Materials*, Vol. 24, pp. 98–120, 2012.

[58] D. R. Smith, D. C. Vier, T. Koschny, and C. M. Soukoulis, "Electromagnetic parameter retrieval from inhomogeneous metamaterials," *Physical Review E*, Vol. 71, pp. 036617, 2005.

[59] Chen, X. D., T. M. Grzegorczyk, B. I. Wu, and J. A. Kong, Robust method to retrieve the constitutive effective parameters of metamaterials," Physical Review E, Vol. 70, 016608, 2004.

[60] N. Fang, H. Lee, C. Sun, and X. Zhang, "Sub diffraction-limited optical imaging with a silver superlens," *Science*, Vol. 38, No. 5721, pp. 534–537, 2005.

[61] A. Grbic and G. V. Eleftheriades, "Overcoming the Diffraction Limit with a Planar Left-Handed Transmission-Line Lens," *Physical Review Letters*, Vol. 92, pp. 117403, 2004.

[62] A. N. Lagarkov and V. N. Kissel, "Near-perfect imaging in a focusing system based on a left-handed-material plate," *Physical Review Letters*, Vol. 92, pp. 077401, 2004.

[63] T. Taubner, D. Korobkin, Y. Urzhumov, G. Shvets and R. Hillenbrand, "Near-field microscopy through a SiC superlens," *Science*, Vol. 313, pp.1595, 2006.

[64] J. B. Pendry, D. Schurig, and D. R. Smith, "Controlling electromagnetic fields," *Science*, Vol. 32, No.5781, pp; 1780–1782, 2006.

[65] A. P. Feresidis, G. Goussetis, S. Wang, and J. (Yiannis) C. Vardaxoglou," Artificial Magnetic Conductor Surfaces and Their Application to Low-Profile High-Gain Planar Antennas", *IEEE Transactions on Antennas and Propagation*, Vol. 53, pp. 209–215, 2005.

[66] R. W. Ziolkowski, "Metamaterial-Based Antennas: Research and Developments," IEICE Trans. Electron., Vol. E89–C, 1267-1275, ,2006.

[67] R. W. Ziolkowski, and A. Erentok," Metamaterial-Based Efficient Electrically Small Antennas", *IEEE Transactions on Antennas and Propagation*, Vol. 54, No. 7, pp. 2113-2130, 2006.

[68] A. Erentok, and R. W. Ziolkowski, "Metamaterial-Inspired Efficient Electrically Small Antennas", *IEEE Transactions on Antennas and Propagation*, Vol. 56, No. 7,pp. 691-707, 2008.

[69] H. A. Majid, M. K. A. Rahim, and T. Masri, "Microstrip antenna's gain enhancement using left-handed metamaterial structure", *Progress in Electromagnetics Research M*, Vol. 8, pp. 235–247, 2009.

[70] I. Gil, F. Martı´n, X. Rottenberg and W. De Raedt, "Tunable stop-band filter at Q-band based on RF-MEMS metamaterials", *Electronics Letters*, Vol. 43, 2007.

[71] P. He, P. V. Parimi, Y. He, V.G. Harris and C. Vittoria, "Tunable negative refractive index metamaterial phase shifter", *Electronics Letters*, Vol. 43, 2007.

[72] M. A. Antoniades, and G. V. Eleftheriades, "Compact Linear Lead/Lag Metamaterial Phase Shifters for Broadband Applications", *IEEE Antennas and Wireless Propagation Letters*, Vol. 2, pp. 103–106, 2003.

[73] F. Bilotti , A. Toscano, K.B. Alici and L. Vegni, "Design of miniaturized narrowband absorbers based on resonant–magntic inclusions," *IEEE Transactions on Electromagntic compatibility*, Vol. 53,pp. 63-72,2011.

[74] A. Toscano and L. Vegni, "Subwavelength microwave absorber with wide angular bandwidth," *IEEE International Symposium on Electromagntic compatibility*, Athens, Greece (Europe), pp.1-4, June 2009.

[75] K. Alici, F. Bilotti , L. Vegni and E. Ozbay, "Experimental Verification of metamaterial based subwavelength microwave absorber," *Journal of Applied Physics*, Vol. 108, pp.083113, 2010.

[76] A. I. M. Ayala , Master of Science Thesis, Tufts University, USA, 2009.

[77] X. Liu, T. Starr, A. F. Starr, and W. J. Padilla, "Infrared spatial and frequency selective metamaterial with near-unity absorbance,"Physical Review Letters,Vol.104, pp. 207403, 2010.

[78] H. Li, L. H. Yuan, B. Zhou, X. P. Shen, and Q. Cheng , "Ultrathin multiband gigahertz metamaterial absorbers," *Journal of Applied. Phys*ics, Vol.110, No.1, pp. 014909, 2011.

[79] S. Bhattacharyya, and K. V. Srivastava, "Ultra-thin metamaterial absorbers using Electric Field Driven LC (ELC) resonator structure," *Progress In Electromagnetics Research Symposium*, Kuala Lumpur, Malaysia, pp. 314-317, March 27–30, 2012.

[80] H.M. Lee, and H.S. Lee, "A metamaterial based microwave absorber composed of coplanar electric field coupled resonator and wire array," *Progress In Electromagnetic Research C*, Vol.34, pp. 111-121, January, 2013.

[81] T. Liu, X. Cao, J. Gao, Q. Zheng, W. Li, and H. Yang, "RCS reduction of waveguide slot antenna with metamaterial absorber", *IEEE Transactions on Antennas and Propagation*, Vol.61, No.3, pp. 1479-1484, 2013.

[82] F. Costa, and A. Monorchio, “Electromagnetic absorbers based on high-impedance surfaces: from ultra-narrowband to ultra-wideband absorption,” *Advanced Electromagnetics*, Vol. 1, No. 3, pp. 7-12, 2012.

[83] Y. Pang, H. Cheng, Y. Zhou, and J. Wang, “Analysis and design of wire based metamaterial absorbers using equivalent circuit approach,” *Journal of Applied Physics*, Vol.113, pp. 114902, 2013.

[84] Y. Avitzour , Y. A. Urzhumov , and G. Shvets , “Wide-angle infrared absorber based on a negative-index plasmonic metamaterial,” *Physical Review B,* Vol.79, pp. 045131, January, 2009.

[85] I. Puscasu, and W. L. Schaich , “Narrow-band, tunable infrared emission from arrays of microstrip patches,”*Applied Physics Letters,* Vol.92, pp. 233102, 2008.

[86] J. Hao , J. Wang , X. Liu , W. J. Padilla , L. Zhou , and M. Qiu , “High performance optical absorber based on a plasmonic metamaterial,” *Applied Physics. Letters*, Vol. 96 , No. 25, pp. 251104, 2010.

[87] N. Liu , M. Mesch , T. Weiss , M. Hentschel , and H. Giessen , “Infrared perfect absorber and its application as plasmonic sensor,” *Nano Letters*, Vol.10, No.7, pp. 2342-2348, 2010.

[88] C. M. Bingham , H. Tao, X. Liu , R. D. Averitt , X. Zhang , and W. J. Padilla, “ Planar wallpaper group metamaterials for novel terahertz applications,” *Optics Express,*Vol.16, No.23, pp. 18565-18575, 2008.

[89] M. H. Li, H.L. Yang, and X.W. Hou, “Perfect metamaterial absorber with dual bands,” *Progress In Electromagnetics Research*, Vol.108, pp. 37-49, 2010.

[90] Z. H. Jiang , S. Yun , F. Toor , D. H. Werner, and T. S. Mayer ,“Conformal dual-band near-perfectly absorbing mid-infrared metamaterial coating,” *ACS Nano,*Vol.5, No.6, pp. 4641-4647, June 28, 2011.

[91] K. B. Alici , A. B. Turhan , C. M. Soukoulis , and E. Ozbay , “Optically thin composite resonant absorber at the near-infrared band: a polarization independent and spectrally broadband configuration,” *Optics Express,*Vol.19, No.15, pp. 14260-14267, 2011.

[92] H. Zhai, C. Zhan, L. Liu, and C. Liang, "A new tunable dual-band metamaterial absorber with wide-angle TE and TM polarization stability," *Journal of Electromagnetic Waves and Applications*, Vol. 29, No. 6, pp. 774–785, 2015.

[93] X. Shen , T. J. Cui , J. Zhao , H. F. Ma , W. X. Jiang, and H. Li, "Polarization-independent wide-angle triple-band metamaterial absorber," *Optics Express*, Vol.*19*, No.10, pp. 9401-9407, 2011.

[94] G. D. Wang, J. F. Chen, X. W. Hu, Z. Q. Chen, and M. H. Liu, "Polarization-insensitive triple-band microwave metamaterial absorber based on rotated square rings," *Progress In Electromagnetics Research*, Vol. 145, pp.175–183, 2014.

[95] D. Chaurasiya, S. Ghosh, S. Bhattacharyya, and K. V. Srivastava, "Dual-band polarization-insensitive metamaterial absorber with bandwidth-enhancement at Ku-band for EMI/EMC application," *IEEE International Microwave and RF Conference (IMaRC),*Banglore, India, pp. 96-99, December 15-17, 2014.

[96] O. T. Gunduz, and C. Sabah,"Polarization angle independent perfect multi- band metamaterial absorber in microwave frequency regime," *New Developments in Computational Intelligence and Computer Science*, 2015.

[97] T. M. Kollatou, and C. S. Antonopoulos, "An array of robust multi-band metamaterial absorbers using octagonal split rings," *International Conference Compumag,* Id. 278 (10), pp. 1-7,Montreal , Quebec, Canada, 28th June–2nd July, 2015.

[98] S. Bhattacharyya, S. Ghosh, and K. V. Srivastava, "An ultra-thin polarization independent metamaterial absorber for triple band applications," *IEEE Applied Electromagnetics Conference (AEMC),* Bhubaneswar, India, pp. 1-2, December 18-20, 2013.

[99] W. Qin, J. Wu, M. Yu, and S. Pan, "Dual-band terahertz metamaterial absorbers using two types of conventional frequency selective surface elements," *Terahertz Science and Technology,* Vol.5, No.4, pp. 169-174, December 2012.

[100] F. Dincer, M. Karaaslan, E. Unal, K. Delihacioglu, and C. Sabah, "Design of polarization and incident angle insensitive dual-band metamaterial absorber based on isotropic resonator," *Progress In Electromagnetics Research*, Vol. 144, pp. 123–132, 2014.

[101] D. Chaurasiya, S. Ghosh, S. Bhattacharyya, and K. V. Srivastava, “An ultrathin quad-band polarization-insensitive wide- angle metamaterial absorber,” *Microwave and Optical Technology Letters*, Vol. 57, No. 3, pp.697-702, March 2015.

[102] N. Wang, J. Tong, W. Zhou, W. Jiang, J. Li, X. Dong, and S. Hu, “Novel quadruple-band microwave metamaterial absorber,” *IEEE Photonics Journal*, Vol. 7, No.1, pp. 5500506, February 02, 2015.

[103] Q. Y. Wen , H. W. Zhang , Y. S. Xie , Q. H. Yang , and Y. L. Liu , “Dual band terahertz metamaterial absorber: design, fabrication and characterization,” *Applied Physics Letters*, Vol.95, No.24, pp. 241111, 2009.

[104] H. Tao , C. M. Bingham , D. Pilon , K. Fan , A. C. Strikwerda ,D. Shrekenhamer, W. J. Padilla , X. Zhang , and R. D. Averitt , “A dual band terahertz metamaterial absorber,” *Journal of Physics D: Applied Physics*,Vol.43, No.22, pp. 225102, 2010.

[105] J. Zhong, Y. Huang, G. Wen, H. Sun, P. Wang, and O. Gordon, “Single-dual-band metamaterial absorber based on cross-circular-loop resonator with shorted stubs,” *Applied Physics A* , Vol. 108, pp. 329–335, 2012.

[106] S. Jamilan, M. N. Azarmanesh, and D. Zarifi “Design and characterization of a dual-band metamaterial absorber based on destructive interferences,” *Progress In Electromagnetics Research C,* Vol. 47, pp. 95–101, 2014.

[107] P. Munaga, S. Ghosh, S. Bhattacharyya, D. Chaurasiya, and K. V.Srivastava,“An ultra-thin dual-band polarization-independent metamaterial absorber for EMI/EMC Applications,” *IEEE 9th European Conference on Antennas and Propagation (EuCAP),* Lisbon, pp 1-4, April, 2015.

[108] M. Y. Bing, Z. H. Wu, L. Y.Xun, W. Y. Cheng, L. W. En, and L. Jie, “Dual-band and polarization-insensitive terahertz absorber based on fractal Koch curves,” *Chinese Physics B,* Vol. 23, No. 5, pp. 058102, 2014.

[109] S. Bhattacharyya and K. V. Srivastava, “Triple band polarization-independent ultra-thin metamaterial absorber using electric field-driven LC resonator”, *Journal of Applied Physics,* Vol. 115, pp. 064508, 2014.

[110] A. Bhattacharya, S. Bhattacharyya, S. Ghosh, D. Chaurasiya, and K. V. Srivastava “An Ultrathin Penta-Band Polarization-Insensitive Compact Metamaterial Absorber For Airborne Radar Applications” *Microwave and Optical Technology Letters* , Vol. 57, No. 11, pp. 2519-2524, 2015.

[111] Available at: http://copradar.com/preview/chapt7/ch7d1.html.

[112] L. Huang, and H. Chen, “Multi-band and polarization insensitive metamaterial absorber,” *Progress In Electromagnetics Research*,Vol.113, pp. 103-110, 2011.

[113] Y. Q. Ye, Y. Jin, and S. He , “Omnidirectional, polarization-insensitive and broadband thin absorber in the terahertz regime,” *Journal of the Optical Society of America B*, Vol.27, No. 3,pp. 498-504, 2010.

[114] H. M. Lee, and H.S. Lee, “A dualband metamaterial absorber based with resonant-magnetic structures,” *Progress In Electromagnetics Research Letters*, Vol.33, pp. 1-12, 2012.

[115] H. M. Lee, “A broadband flexible metamaterial absorber based on double resonance,” *Progress In Electromagnetics Research Letters*, Vol.46, pp.73–78, 2014.

[116] J. Zhuge, D. Bao, X. Shen, and T. Cui,“Multiband THz metamaterial absorber based on snowflake-type resonators,” *Progress In Electromagnetics Research Symposium Proceedings*, Guangzhou, China, pp. 1093-1096, August 25-28, 2014.

[117] D. Zheng, Y. Cheng, D. Cheng, Y. Nie, and R. Gong,“Four-band polarization-insensitive metamaterial absorber based on flower-shaped structures,” *Progress In Electromagnetics Research*, Vol. 142, pp. 221–229, 2013.

[118] J. W.Park, P. V. Tuong, J. Y. Rhee, K. W. Kim, W. H. Jang, E. H. Choi, L. Y. Chen, and Y. P. Lee, “Multi-band metamaterial absorber based on the arrangement of donut-type resonators,” *Optics Express*, Vol. 21, pp. 9691-9702, 2013.

[119] O. Ayop, M. K. A. Rahim, N. A. Murad, N. A. Samsuri, and R. Dewan, “Triple band circular ring-shaped metamaterial absorber for X-band applications,” *Progress In Electromagnetics Research M*, Vol.39, pp. 65–75, 2014.

[120] S. Bhattacharyya, S. Ghosh, and K. V. Srivastava, "Triple band polarization-independent metamaterial absorber with bandwidth enhancement at X-band," *Journal of Applied Physics,* Vol. 114, No. 9, pp. 094514, 2013.

[121] H. Yang, X. Cao, J. Gao, W. Li, Z. Yuan, and K. Shang, "Low RCS metamaterial absorber and extending bandwidth based on electromagnetic resonances," *Progress In Electromagnetics Research M*, Vol. 33, pp.31–44, 2013.

[122] H. Xiong, J. S. Hong, C. M. Luo, and L. L. Zhong, "An ultrathin and broadband metamaterial absorber using multi-layer structures," *Journal of Applied Physics*, Vol.114, pp.064109, 2013.

[123] B. Y. Wang, S. B. Liu, B. RuiBian, Z. W. Mao, X. C. Liu, B. Ma, and L. Chen, "A novel ultrathin and broadband microwave metamaterial absorber," *Journal of Applied Physics,*Vol. 116, pp. 094504, 2014.

[124] S. Bhattacharyya, S. Ghosh, D. Chaurasiya, and K. V. Srivastava, "Bandwidth-enhanced dual-band dual-layer polarization-independent ultra-thin metamaterial absorber," *Applied Physics A*, Vol.118, pp. 207–215, 2015.

[125] S. Li, X. Cao, T. Liu, and H. Yang, "Double-layer perfect metamaterial absorber and its application for RCS reduction of antenna," *Radioengineering*, Vol. 23, No. 1, pp. 222-228, April, 2014.

[126] Y. Liu, W. Tang, and Y. Ge "A wideband metamaterial absorber based on multilayer rings and lumped resistors," *Progress In Electromagnetics Research Symposium Proceedings*, Guangzhou, China, pp. 1053-1056, Aug. 25–28, 2014.

[127] H. Luo, Y. Z. Cheng, and R. Z. Gong , "Numerical study of metamaterial absorber and extending absorbance bandwidth based on multi-square patches,"*European. Physics Journal B*, Vol.81, pp.387-392, 2011.

[128] H. Luo, T. Wang, R. Z. Gong, Y. Nie, and X. Wang , "Extending the bandwidth of electric ring resonator metamaterial absorber," *Chinese Physics. Letters*,Vol.28, pp. 034204, 2011.

[129] H. M. Lee, and H. S. Lee, "A method for extending the bandwidth of metamaterial absorber," *International Journal of Antennas and Propagation*, Id no. 859429, pp.1-7, 2012.

[130] S. Bhattacharyya, S. Ghosh, and K. V. Srivastava "Bandwidth-enhanced metamaterial absorber using electric field–driven LC resonator for airborne radar applications," *Microwave and Optical Technology Letters*, Vol. 55, No. 9, pp. 2131-2137, September 2013.

[131] S. Ghosh, S. Bhattacharyya, and K. V. Srivastava, "Design of a bandwidth-enhanced ultra- thin metamaterial absorber," *Progress in Electromagnetics Research Symposium Proceedings*, Taipei, pp.1097-1101, March 25–28, 2013.

[132] S. Ghosh, S. Bhattacharyya, and K. V. S rivastava, "Bandwidth-enhancement of an ultrathin polarization insensitive metamaterial absorber," *Microwave and Optical Technology Letters*, Vol. 56, No. 2, pp. 350-355, 2014.

[133] H. X. Liu, B. F. Yao, L. Li, and X. W. Shi "Analysis and design of thin planar absorbing structure using Jerusalem cross slot," *Progress In Electromagnetics Research B*, Vol. 31, pp.261–281, 2011.

[134] G. Chao, S. B. Qu, Z. B. Pei, H. Zhou, X. Zhiy, B. Peng, P. Dong, and L. Qin , "Planar metamaterial absorber based on lumped elements," *Chinese Physics Letters*,Vol.27, No.11, pp. 117802, 2010.

[135] S. Gu, J. P. Barrett, T. H. Hand, B.-I. Popa, and S. A. Cummer, " A broadband low-reflection metamaterial absorber," *Journal of Applied Physics*, Vol.108, pp.064913, 2010.

[136] Y. Z. Cheng, Y. Wang, Y. Nie, R. Z. Gong, X. Xiong, and X. Wang, "Design, fabrication and measurement of a broadband polarization- insensitive metamaterial absorber based on lumped elements," *Journal of Applied Physics*,Vol. 111, pp. 044902, 2012.

[137] W. Yuan, and Y. Cheng, "Low-frequency and broadband metamaterial absorber based on lumped elements: design, characterization and experiment*,"* *Applied Physics A*, Vol. 117, No. 4, pp.1915–1921, 2014.

[138] H. M. Lee "Absorption bandwidth-enhanced metamaterial absorber using in-planed ELC resonator and cut-wire," *Electrical and Electronic Engineering,* Vol. 4, No.4, pp. 73-79, 2014.

[139] Z. Mao, S. Liu, X. Kong, B. Bian, B. Wang, and L. Chen,"Design and analysis of a wideband metamaterial absorber applied to radome," *Progress In Electromagnetics Research Proceedings*, Guangzhou, China, pp. 944-947, August 25–28, 2014.

[140] J. Lee, and S. Lim, "Bandwidth-enhanced and polarisation-insensitive metamaterial absorber using double resonance," *Electronics Letters*, Vol. 47, 6th January 2011.

[141] S. Ghosh, S. Bhattacharyya,Y. Kaiprath, and K. V. Srivastava, "Bandwidth-enhanced polarization-insensitive microwave metamaterial absorber and its equivalent circuit model," *Journal of Applied Physics*, Vol. 115, pp.104503, 2014.

[142] S. Ghosh, S. Bhattacharyya, D. Chaurasiya, and K. V. Srivastava, "An ultra -wideband ultra -thin metamaterial absorber based on circular split rings," IEEE *Transsactions on Antennas Propagation Letters*, Vol. 14, pp.1172–1175, 2015.

[143] S. Bhattacharyya, S. Ghosh, D. Chaurasiya, and K. V. Srivastava, "A broadband wide angle metamaterial absorber for defense applications," *IEEE International Microwave and RF Conference (IMaRC)*, Banglore, India, pp. 33-36,December 15-17, 2014.

[144] R.C. Parida, D. Singh, N. K. Agarwal, "Implementation of multilayer ferrite radar absorber coating with genetic algorithm for radar cross section reduction at X-band," *Indian Journal of Radio & Space Physics*, Vol. 36, pp. 145-152, 2007.

[145] J. H. Oh, K. Oh, C. G. Kim, and C. S. Hong, "Design of radar absorbing strcutures using glass/epoxy composite containing carbon black in X-band frequency ranges," *Composites Part B: Engineering*, Vol. 35, pp. 49-56, 2004.

[146] High Frequency Structure Simulator, Ansys, Incorporation, Canonsburg, PA,USA, at http://www.ansys.com.

[147] Somak Bhattacharyya "Studies on Ultra-thin Microwave Metamaterial Absorber for Multiband and Wideband Applications" Ph.D. Thesis, Department of Electrical Engineering, Indian Institute of Technology, Kanpur, January, 2015.

[148] S.Ghosh, and K. V. Srivastava, "An equivalent circuit model of FSS-based metamaterial absorber using coupled line theory," *IEEE Antennas & Wireless Propagation Letters*, Vol. 14, pp. 511–514, 2015.

[149] S. Bhattacharyya, S. Ghosh, D. Churasiya, K.V. Srivastava, "Wide-angle broadband microwave metamaterial absorber with octave bandwidth" *IET Microwave Antennas Propagation*, Vol. 9, pp.1160 – 1166, 2015.

[150] H. X. Xu, G. M. Wang, M.Q. Qi, J.G. Liang, J.Q. Gong, Z.M. Xu, "Triple–Band Polarization Insensitive Wide-Angle Ultra-Miniature Metamaterial Transmission Absorber", *Physics Review B*, Vol. 86, pp. 205104, 2012.

[151] F. Costa, S. Genovesi, A. Monorchio, G. Manara, "A circuit based model for the interpretation of perfect metamaterial absorbers", IEEE Transactions Antennas Propagations, Vol. 61, pp.1201-1209, 2013.

[152] J. Ma, W. Tong, K. Shi, X. Cao, B. Gong, "A Broadband Metamaterial Absorber Using Fractal Tree Structure", *Progress In Electromagnetics Research Letters*, Vol. 49, pp. 73–78, 2014.

[153] M. Yoo and S. Lim, "Polarization independent and ultra-wideband metamaterial absorber using a hexagonal artificial impedance surface and a resistor-capacitor layer," *IEEE Transactions on Antennas Wireless Propag*ation, Vol. 62, pp. 2652–2658, 2014.

[154] Y. Liu, S.Gu, C. Luo, X. Zhao, "Ultra-thin broadband metamaterial absorber" *Applied Physics A*, Vol. 108, No. 1, pp. 19-24, 2012.