Caroline A. Ross

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Education

Cambridge University,	Cambridge, UK	Materials Science and Metallurgy	B.A. 1985
Cambridge University,	Cambridge, UK	Materials Science and Metallurgy	Ph.D. 1988
Harvard University,	Cambridge, MA, USA	Postdoctoral Fellow, Engineering and Applied Sciences	1989-1990

Appointments

Massachusetts Institute of Technology	Professor	2004-current
	Interim Department Head, DMSE	2023-2024
Massachusetts Institute of Technology	Associate Professor	2000-2004
Massachusetts Institute of Technology	Assistant Professor	1997-2000
Komag Inc.	Engineer	1991-1997

Fellow of American Physical Society, Institute of Physics (UK), Materials Research Society, and IEEE

Research Interests

Magnetic and multiferroic oxides and nanocomposites; self-assembly of block copolymers for nanofabrication

Selected publications (out of ~500, h-index = 89, 31,000 citations)

An antisite defect mechanism for room temperature ferroelectricity in orthoferrites, Shuai Ning, Abinash Kumar, Konstantin Klyukin, Eunsoo Cho, Jong Heon Kim, Tingyu Su, Hyun-Suk Kim, James M. LeBeau, Bilge Yildiz and Caroline A. Ross, ***Nat. Commun***. 12 4298 (2021)

Relativistic Kinematics of a Magnetic Soliton, Lucas Caretta, Se-Hyeok Oh, Takian Fakhrul, Dong-Kyu Lee, Byung Hun Lee, Se Kwon Kim, Caroline A. Ross, Kyung-Jin Lee, and Geoffrey S. D. Beach, ***Science*** 370(6523) p1438-1442 (2020)

Interface-driven chiral magnetism and current-driven domain walls in insulating magnetic garnets, Can Onur Avci, Ethan Rosenberg, Lucas Caretta, Felix Büttner , Maxwell Mann, Colin Marcus, David Bono, Caroline A. Ross and Geoffrey S. D. Beach, ***Nature Nanotechnology*** 14 561–566 (2019)

Monolithic integration of broadband optical isolators for polarization-diverse silicon photonics, Yan Zhang, Qingyang Du, Chuangtang Wang, Takian Fakhrul, Shuyuan Liu, Longjiang Deng, Duanni Huang, Paolo Pintus, John Bowers, Caroline A. Ross, Juejun Hu, and Lei Bi, ***Optica*** 6(4) 473-478 (2019)

Current-Induced Switching in a Magnetic Insulator, Can Onur Avci, Andy Quindeau, Chi-Feng Pai, Maxwell Mann, Lucas Caretta, Astera S. Tang, Mehmet C. Onbasli, Caroline A. Ross, and Geoffrey S. D. Beach, ***Nature Materials*** 15(12), 309–314 (2017)

IP Bridge Exhibit 2054
Western Digital v. IP Bridge
IPR2024-01494

Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator, Chunhui Du, Toeno Van der Sar, Tony X. Zhou, Pramey Upadhyaya, Francesco Casola, Huiliang Zhang, Mehmet C. Onbasli, Caroline A. Ross, Ronald L. Walsworth, Yaroslav Tserkovnyak, Amir Yacoby, ***Science*** Vol. 357, Issue 6347, pp. 195-198 (2017)

Templating Three-Dimensional Self-Assembled Structures in Bilayer Block Copolymer Films, A.T.K. Ghariehali, K.W. Gotrik, A.F. Hannon, A. Alexander-Katz, C.A. Ross, K. K. Berggren, ***Science*** 336 1294 (2012)

On-chip optical isolation in monolithically integrated nonreciprocal optical resonators, Lei Bi, Juejun Hu, Peng Jiang, Dong Hun Kim, Gerald F. Dionne, Lionel C. Kimerling and C. A. Ross, ***Nature Photonics*** 5, 758–762 (2011)

Complex self-assembled patterns using sparse commensurate templates with locally varying motifs, Joel K. W. Yang, Yeon Sik Jung, Jae-Byum Chang, Caroline A. Ross, and Karl K. Berggren, ***Nature Nanotechnology*** 5, 256-260 (2010)

Graphoepitaxy of self-assembled block copolymers on 2D periodic patterned templates, Ion Bita, Joel K.W. Yang, Yeon Sik Jung, Caroline A. Ross, Edwin L. Thomas, Karl K. Berggren, ***Science*** 321 (5821) p939-943 (2008)

Nanostructure Engineering by Templated Self-Assembly, J.Y. Cheng, C.A. Ross, A. Mayes, ***Nature Materials*** 3 823-8 (2004)

Formation of a cobalt magnetic dot array via block copolymer lithography, J.Y. Cheng, C.A. Ross, V.Z.H. Chan, E.L. Thomas, R.G.H. Lamertink and G.J. Vancso, ***Advanced Materials*** 13 1174-8 (2001)

Other Activities

- *Organizations*: Fellow, American Physical Society; Fellow, Institute of Physics (UK); Fellow, Materials Research Society; Fellow, IEEE; Secretary/Treasurer, APS Topical Group on Magnetism, 2004-08; Member-at-Large, Executive Committee, APS Division of Condensed Matter Physics 2004-07; Editorial Board, J. Physics D: Applied Physics 2004-10; Appl. Phys. Lett/J. Appl Phys. 2009-14; J. Magn. Magn. Mater. 2009-14; Councillor, Materials Research Society 1999-2001; Executive Committee, 2001.
- *Conferences and Journals*: Chair, MMM (Magnetism and Magnetic Materials) Conference 2011; Publications Chair, Intermag 2003; Publications Editor, Intermag 2000, Joint Intermag/MMM 2001, and Intermag 2002 Conferences; Program Cttee, JEMS Conferences 2009-; EIPBN 2009-; Meeting Chair, Materials Res. Soc. Spring 1998 Mtg., and Symposium co-organizer, 1994, 1995, 2024, 2025
- *Books/patents:* Edited two books; 21 U.S. patents awarded, >500 publications.

Publications of Caroline A. Ross

Journal Articles

1. Ross, C.A. and J.E. Evetts, "A model for electromigration behavior in terms of flux divergences," Scripta Metall. 21, 1077-82 (1987)

2. Schwarzenberger, A.P., C.A. Ross, J. E. Evetts and A. L. Greer, "Electromigration in the presence of a temperature gradient: Experimental study and modeling," J. Electr. Mater. 17 (5), 473-7 (1988)

3. Ross, C.A., R.E. Somekh and J.E. Evetts, "A temperature-gradient technique for measuring the activation energy for electromigration," Thin Solid Films, 173 L129-133, (1989)

4. Ross, C.A., J.S. Drewery, R.E. Somekh and J.E. Evetts, "The effect of anodization on the electromigration drift velocity in aluminum films," J. Appl. Phys. 66, 2349-55 (1989)

5. Goldman, L.M., C.A. Ross, W. Ohashi, D. Wu and F. Spaepen, "A new dual-bath technique for electrodeposition of short repeat-length multilayers," Appl. Phys. Lett. 55, 2182-4 (1989)

6. Ross, C.A., J. S. Drewery, R. E. Somekh and J. E. Evetts, "Electromigration and mechanical stress in aluminum conductor tracks passivated by anodization," J. Electron. Mater. 19(9), 911-8 (1990)

7. Ross, C.A., D.T. Wu, L.M. Goldman and F. Spaepen, "Measurements of interdiffusion in electrodeposited nickel-phosphorus multilayers," J. Appl. Phys. 72, 2773-80 (1992)

8. Ross, C.A., L. M. Goldman and F. Spaepen, "An electrodeposition technique for producing multilayers of nickel-phosphorus and other alloys," J. Electrochem. Soc., 140 (1), 91-8 (1993)

9. Ross, C.A., "Anisotropic stress in window-plated permalloy thin films," IEEE Trans. Mag. 29 (5), 2266-72 (1993)

10. Ross, C.A., M.E. Schabes, R. Ranjan and T. Chen, "The role of stress- induced anisotropy in longitudinal thin film magnetic recording media", J. Applied Physics 79, 5342-4 (1996)

11. Ross, C.A., "Properties of R.F sputtered alumina films on flat and grooved substrates," J. Vac. Sci. Technol. A 14 (4), 2511-6 (1996)

12. Tang, K., M.R. Visokay, C.A. Ross, R. Ranjan, T. Yamashita and R. Sinclair, "Lorentz transmission electron microscopy study of micromagnetic structures in real computer hard disks," , IEEE Trans. Mag. 32 (5) 4130-2 (1996)

13. Ross, C.A., T. Nolan, R. Ranjan and D. Lu, "The role of NiAl underlayers in longitudinal recording media," J. Appl. Phys. 81(11) 7441-4 (1997)

14. Tang, K., M.E. Schabes, C.A. Ross, L. He, R. Ranjan, T. Yamashita and R. Sinclair, "Magnetic clusters, intergranular exchange interaction and their microstructural basis in thin film longitudinal media", IEEE Trans. Magn., 33 4074-6 (1997)

15. Ross, C.A., F.M. Ross, G. Bertero and K. Tang, "Microstructural evolution and thermal stability of thin CoCrTa/Cr films for longitudinal recording media," IEEE Trans. Magn. 34 282-92 (1998)

16. Wittig, J.E., T.P. Nolan, M. Schabes, C.A. Ross, K. Tang, R. Sinclair and J. Bentley, "Chromium segregation in CoCrTa/Cr thin films for longitudinal recording media," IEEE Trans. Magn. 34 1564-6 (1998)

17. Farhoud, M., M. Hwang, H.I. Smith, J.M. Bae, K. Youcef-Toumi and C.A. Ross, "Fabrication of large area nanostructured magnets by interferometric lithography", IEEE Trans. Magn. 34 1087-9 (1998)

18. Savas, T.A., M. Farhoud, M. Hwang, H.I. Smith and C.A. Ross, "Properties of large-area nanomagnet arrays with 100 nm period made by interferometric lithography", J. Appl. Physics 85 6160-2 (1999)

19. Twisselmann, D.J., M. Farhoud, H.I. Smith and C.A. Ross, "In-plane magnetic anisotropy in CoCrPt and CoCrTa films deposited onto patterned silicon substrates", J. Appl. Physics 85 4292-4 (1999)

20. Ross, C.A., T.A. Savas, H.I. Smith and R. Chantrell, "Modelling of hysteresis loops of arrays of 100 nm period nanomagnets", IEEE Trans. Magn. 35 3781-3 (1999)

21. Farhoud, M., J. Ferrera, A.J. Lochtefeld, M.L. Schattenburg, C.A. Ross and H.I. Smith, "Fabrication of 200nm period nanomagnet arrays using interferometric lithography and a negative resist", J. Vac. Sci. Technol. B17 3182-5 (1999)

22. Ross, C. A., H.I. Smith, T. Savas, M. Schattenburg, M. Farhoud, M. Hwang, M. Walsh, M. Abraham, R. Ram "Fabrication of Patterned Media for High Density Magnetic Storage", J. Vac. Sci. Technol. B17 3168-76 (1999) [abstract also appears in Microelectr. Eng. 53 67 (2000)]

23. Wang J.Q., L.M. Malkinski, Y. Hao, C.A. Ross, J.A. Wiemann and C. O'Connor, "Fabrication of pseudo-spin-valves and 100 nm sized periodic elements for magnetic memory application", Mater. Sci. Eng. B76 1-5 (2000)

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25. Farhoud M., H.I. Smith, M. Hwang and C.A. Ross "The effect of aspect ratio on the magnetic anisotropy of particle arrays", J. Appl. Phys. 87 5120-2 (2000)

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27. Hao Y., M. Walsh, C.A. Ross, H.I. Smith, J. Wang, L. Malkinski, "In-plane anisotropy in arrays of magnetic ellipses", IEEE Trans. Magn. 36 2996-8 (2000)

28. Shima M., A.C. Ford and C.A. Ross, "Crystallographic and magnetic properties of Cr/CoCr(Ta,Pt) films produced by pulsed laser deposition", IEEE Trans. Magn. 36 2321-3 (2000); Correction 37 3079 (2001)

29. Twisselmann D, Y.J. Shine and C.A. Ross, "Correlation of stress and magnetic anisotropy in Cr/CoCrPt films grown on textured substrates", IEEE Trans. Magn. 36 2324-6 (2000)

30. Hsu C-C., R.S. Indeck, A. Jander, M.W. Muller, C.A. Ross, and D.J. Twisselmann, "MFM observation of magnetization reversal process in recording media with lithographically defined texture", IEEE Trans. Magn. 36 2327-9 (2000)

31. Hwang M., M. Farhoud, Y. Hao, M. Walsh, T.A. Savas, H.I. Smith, C.A. Ross, "Major hysteresis loop modelling of two-dimensional arrays of single-domain particles", IEEE Trans. Magn. 36 3173-5 (2000)

32. Walsh M., Y. Hao, C.A. Ross, H.I. Smith, "Optimization of a lithographic and ion beam etching process for nanostructuring magnetoresistive thin film stacks", J. Vac. Sci. Technol. B18 3539-3543 (2000)

33. Ross C.A., R. Chantrell, M. Hwang, M. Farhoud, T.A. Savas, Y. Hao, H.I. Smith, F.M. Ross, M. Redjdal and F.B. Humphrey, "Incoherent magnetization reversal observed in 30-nm Ni particles", Phys. Rev. B 62 14252-8 (2000)

34. Ross C.A., M. Farhoud, M. Hwang, H.I. Smith, M. Redjdal and F.B. Humphrey, "Micromagnetic behavior of conical ferromagnetic particles", J. Appl. Phys. 89 1310-9 (2001)

35. Castaño F. J., Y. Hao, S. Haratani, C.A. Ross, B. Vögeli, M. Walsh and Henry I. Smith, "Magnetic Switching in 100nm Patterned Pseudo Spin Valves", IEEE Trans. Magn. 37 2073-5 (2001)

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39. C. Park, J.Y. Cheng, M.J. Fasolka, A.M. Mayes, C.A. Ross, E.L. Thomas, C. de Rosa, "Double textured cylindrical block copolymer domains via directional solidification on a topographically patterned substrate", Appl. Phys. Letts. 79 848-50 (2001)

40. F.J. Castaño, B. Vogeli, Y. Hao, S. Haratani, M. Hwang, Henry I. Smith, and C.A. Ross, "Magnetization reversal in sub-100 nm pseudo spin valve element arrays", Appl. Phys. Letts. 79 1504 (2001)

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45. C.A. Ross, S. Haratani, F.J. Castaño, Y. Hao, M. Hwang, M. Shima, J.Y. Cheng, B. Vogeli, M. Farhoud, M. Walsh, H.I. Smith, "Magnetic behavior of lithographically patterned particle arrays", J. Appl. Phys. 91 6848-53 (2002)

46. F.J. Castaño, Y. Hao, C.A. Ross, B. Vogeli, Henry I. Smith, S. Haratani, "Switching field trends in sub-100 nm pseudo spin valve arrays", J. Appl. Phys. 91 7317-9 (2002)

47. M. Shima, T. Tepper, C.A. Ross, "Magnetic properties of chromium oxide and iron oxide films produced by pulsed laser deposition J. Appl. Phys. 91 7920-22 (2002)

48. N. Dao, S.L. Whittenburg, Y. Hao, C.A. Ross, L.M. Malkinski, J.Q. Wang, "Magnetization reversal of elliptical Co/Cu/Co pseudo-spin-valve dots", J. Appl. Phys. 91 8293-5 (2002)

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53. D. Twisselmann, P.G. Chambers, C.A. Ross, G. Khanna, B. Clemens, "The Origins of Substrate-Topography-Induced Magnetic Anisotropy in Sputtered Cobalt Alloy Films", J. Appl. Phys. 92 3223-30 (2002)

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55. T. Deng, Sam Ha, J.Y. Cheng, C.A. Ross, E.L. Thomas, "Micropatterning of block copolymer in solution", Langmuir 18 6719-22 (2002)

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84. F.J. Castaño, K. Nielsch, C.A. Ross, J.W.A. Robinson, R. Krishnan, "Anisotropy and magneto-transport in ordered magnetic antidot arrays", Applied Physics Letters 85 2872-4 (2004)

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