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RESEARCH INTERESTS AND SPECTROSCOPIES

Magnetic Materials, Interfacial magnetism, Permanent magnets, Magnetic multilayers, CMR materials, High Temperature Superconductivity, Polarons, Local structure, Phase transitions, Amorphous materials, Metal-Insulator transition; X-ray Magnetic Circular Dichroism (XMCD), X-ray Resonant Magnetic Scattering (XRMS), Magnetic Diffraction Anomalous Fine Structure (MDAFS), X-ray Absorption Fine Structure (XAFS), X-ray Magnetic Microscopy, Electron Energy Loss Spectroscopy (EELS), Mössbauer Spectroscopy.

CURRENT RESEARCH ACTIVITIES

I am currently focused on the development of x-ray techniques that use circularly polarized x-rays to study magnetic materials. These include Magnetic Reflectivity for studies of interfacial magnetic structure, Magnetic DAFS for studies of element- and site- specific magnetism, Magnetic-XAFS for studies of local magnetic ordering, and Magnetic microscopy for imaging and characterization with micron resolution.

EMPLOYMENT

Physicist –Argonne National Laboratory	May 2005- Present
Assistant Physicist –Argonne National Laboratory	May 2001-May 2005
Post-doctoral Research Associate Argonne National Laboratory	August 1999- May 2001
University of Washington	March 1998 - July 1999

EDUCATION

Ph.D. in Physics	University of Washington	1998
Thesis: <i>Local structural studies of oriented high temperature superconducting cuprates by polarized XAFS spectroscopy.</i>		
Advisor: Edward A. Stern		
M.Sc. in Physics	Technion, Israel	1992
Thesis: <i>Effect of impurities on dynamical properties of dilute metallic binary alloys.</i>		
Advisor: Hanan Shechter		
B.Sc. in Physics	Technion, Israel	1989

RESEARCH EXPERIENCE

X-ray studies of interfacial magnetism: Combined x-ray resonant magnetic scattering and magnetic circular dichroism techniques to measure and quantify the spatial extent and strength of magnetic exchange coupling at buried interfaces of layered structures. These techniques revealed the existence of induced Gd magnetization near the Gd/Fe interface and determined its spatial extent. Generalized computer codes were developed to retrieve magnetization density profiles from layered structures within the first Born approximation, and to obtain anomalous magnetic scattering factors from XMCD measurements [*Physical Review Letters* **87**, 207201 (2001); *Physical Review B* **70**, 134420 (2004)].

X-ray studies of inhomogeneous magnetic states in artificial nanostructures Combined x-ray Magnetic Circular Dichroism (XMCD) with penetration depth tunability of x-rays near the critical angle for total external reflection to probe the nucleation of magnetic twisted phases in Gd/Fe multilayers. This method allowed probing near-surface and bulk magnetic states in a single measurement and revealed the nucleation of a spatially inhomogeneous magnetic state at the surface of an artificial Gd/Fe multilayer [*Phys. Rev. B (Rapid Communications)* **67**, 180406(R) (2003); *J. Appl. Phys.* **93**, 6507 (2003); *Phys. Rev. B* **73**, 174401 (2006),].

X-ray studies of element- and site-specific magnetism in single crystals Exploited the symmetry properties of crystals in combination with resonant scattering of circularly polarized (CP) x-rays to obtain site-selective magnetic information in single crystals. This technique allowed measuring site-selective magnetization reversals in permanent magnetic materials providing an atomic look at the origins of magneto-crystalline anisotropy in best permanent magnet Nd₂Fe₁₄B [*IEEE Transactions on Magnetics* **40**, 2874 (2004); *Phys. Rev. Lett.* **95**, 217207 (2005), *Phys. Rev. B* **73**, 144416 (2006),]. Developed a digital lock-in system for detection of dichroic diffraction of CP x-rays (U.S. Patent under review).

X-ray absorption studies of local structure of molecular magnets and amorphous magnetic semiconductors Applied X-ray absorption fine structure (XAFS) and near edge structure (XANES) techniques to determine the chemical oxidation state and local atomic structure around Vanadium in the disordered Vanadium tetracyanoethylene V[TCNE] room-temperature molecule-based magnet and related compounds [*Phys. Rev. B* **70**, 054422 (2004)]. Use XAFS to measure local atomic disorder in amorphous Gd_xSi_{1-x} magnetic semiconductors [*Phys. Rev. B* **67**, 115207 (2003)].

X-ray microscopy studies of magnetic domains: Studied magnetic domain structure in epitaxial bilayers of exchange spring magnet Fe/SmCo. The x-ray microprobe couples phase-retarding optics with K-B mirrors to yield a 1 μm CP x-ray beam with switchable helicity. This tool was used to image domains in the SmCo buried layer and to image biquadratic coupling between layers [*J. App. Phys.* **89**, 7165 (2001)]. The microscope was also used to study magnetization reversal of patterned, sub-micron, pseudo-spin valve structures [*J. Appl. Phys.* **95**, 7028 (2004)]. Added low temperature capability to the magnetic microscope [*Rev. Sci. Instr.* **76**, 063702 (2005)].

XAFS studies of local structure in high T_c superconductors: Used the orientation dependence of X-ray Absorption Fine Structure (XAFS) in the anisotropic layered structures of high T_c superconductors to measure local atomic arrangements at structural phase transitions and around dopant atoms. Developed methods for preparation of magnetically aligned powders for fluorescence experiments. These measurements revealed, among others, the partial order-disorder nature of the Sr-induced phase transition in La_{2-x}Sr_xCuO₄ [*Phys. Rev. Lett.* **76**, 439 (1996)], the polaronic nature of hole carriers doped by Sr in La_{2-x}Sr_xCuO₄ [*Phys. Rev. B (Rapid Communications)* **56**, R521 (1997)], the high spin non Jahn-Teller state of Ni in La_{2-x}Sr_xCu_{1-y}Ni_yO₄ [*Phys. Rev. B* **64**, 104510 (2001)] and the large local disorder in tilt angle of CuO₆ octahedra present in La_{1.875}Ba_{0.125}CuO₄ [*Phys. Rev. B* **61**, 7055 (2000)].

Electron microscopy studies of local atomic structure of materials: Contributed to the development of the EXELFS technique (Extended Energy Loss Fine Structure) as a structural tool with high spatial resolution (50Å -1µm) in the Transmission Electron Microscope (TEM). Main contributions include improvements in data analysis and quantifying the effect of electron radiation damage as a limitation to high spatial resolution [*Micron* **30**, 185-194 (1999), *Ultramicroscopy* **58** n.3-4 p.353 (1995)].

Mössbauer studies of impurities in metals: Used Mössbauer spectroscopy on the ¹¹⁹Sn isotope to study local dynamics and electronic properties of Sn impurities in Ag, Pb and Au metal hosts. Unusually large dynamics of Sn atoms was found at high temperatures, providing new clues into the role of point defects on lowering the melting temperature of dilute binary alloys [*Phys. Rev. B* **47**, 14032 (1993), *J. Phys. Cond. Matt.* **10**, 8573 (1998)].

TEACHING EXPERIENCE

Supervises post-doctoral appointees (3) and graduate students (2)	2001-Present
Teaching Assistant, University of Washington Led problem session of electrodynamics courses for advanced undergraduate students.	1992-1993
Teaching Assistant, Technion Laboratory instructor for introductory physics courses.	1989-1990

COMPUTER EXPERTISE

Experience in FORTRAN and C scientific programming. Experience with script language programming (PERL, C-shell) as well as working knowledge of UNIX, LINUX and Windows based operating systems and a variety of software running on these platforms.

SOFTWARE DEVELOPMENTS

- Wrote a generalized code to retrieve magnetization density profiles in multilayers from fits of magnetic reflectivity data using the first Born approximation (1999-2001).
- Wrote a generalized Kramers-Krönig code to obtain accurate charge and magnetic anomalous scattering factors from XANES and XMCD measurements (2000-2001).
- Wrote a generalized code to simulate site-specific x-ray resonant dichroic diffraction of CP x-rays from crystals using ab-initio calculations of resonant scattering factors (2002-2004).
- Wrote a generalized code to correct X-ray Absorption Near Edge Structure (XANES) data for self absorption effects in fluorescence experiments (1998).

LANGUAGES

Fluent in English, Spanish and Hebrew.

AWARDS

International Union of Crystallography Young scientist award	2000
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FUNDING

Laboratory Directed Research and Development (LDRD) funding	
<i>Site-specific magnetism in crystals</i> \$110K	2004
\$96K	2005

PATENTS

<i>Digital Lock-in detection of site-specific magnetism in magnetic materials</i> (pending)	2006
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OTHER ACTIVITIES

- Member of the Advanced Photon Source Colloquium Committee. 2004-2006
- Neutron and x-ray scattering ANL summer school instructor (XMCD). 2002-2004
- Advisor to the x-ray absorption SR community in Spain on needs and design for XAS/XMCD beamline at ALBA light source. 2004
- Member General User Program spectroscopy panel. 2006-present
- Referees papers for PRL, PRB, APL, JAP, JPCM, and JSR journals. 1996-Present

PROFESSIONAL ASSOCIATIONS

Member of the American Physical Society

Member of the International XAFS Society

SELECTED PUBLICATIONS (58 publications, 48 refereed, 25 first author)

- *Atomic Origin of Magnetocrystalline anisotropy in Nd₂Fe₁₄B* **D. Haskel**, J. Lang, Z. Islam, A. Cady, G. Srajer, M. van Veenendaal, P. Canfield, *Phys. Rev. Lett.* **95**, 217207 (2005).
- *Local structural order in the disordered Vanadium tetracyanoethylene room-temperature molecule-based magnet* **D. Haskel**, Z. Islam, J. Lang, C. Kmety, G. Srajer, K. Pokhodnya, A. Epstein, J. Miller. *Phys. Rev. B* **70**, 054422 (2004) .
- *Four unit-cell superstructure in the optimally doped YBCO spureconductor* Z. Islam, X. Liu, S. Sinha, J. Lang, S. Moss, **D. Haskel**, G. Srajer, P. Wochner, D. Lee, D. Haeffner, U. Welp. *Phys. Rev. Lett.* **93**, 157008 (2004).
- *Nature of inhomogeneous magnetic state in artificial Fe/Gd ferrimagnetic multilayers* **D. Haskel**, G. Srajer, Y. Choi, D.R. Lee, J. C. Lang, J. Meersschant, J.S. Jiang, S.D. Bader. *Physical Review B (Rapid Communications)* **67**, 180406(R) (2003).
- *Magnetization reversal measurements in ferromagnetic antidot arrays by vector magnetometry with x-ray magnetic circular dichroism* D.R. Lee, Y. Choi, C-Y.You, J. Lang, **D. Haskel**, V. Metlushko, S. Bader and G. Srajer. *Appl. Phys. Lett.* **81**, 4997 (2002)
- *Enhanced Interfacial Magnetic Coupling of Gd/Fe Multilayers* **D. Haskel**, G. Srajer, J. Lang, J.Pollmann, C. Nelson, J. Jiang, S. Bader. *Phys. Rev. Lett.* **87**, 207201 (2001).
- *XAFS study of the low-temperature tetragonal phase of La(2-x)Ba(x)CuO(4): Disorder, stripes and Tc suppression at x=0.125* **D. Haskel**, E. A. Stern, F. Dogan and A. Moodenbaugh. *Phys. Rev. B* **61**, 7055 (2000).
- *Altered Sr environment in La_{2-x}Sr_xCuO₄* **D. Haskel**, E. A. Stern, D. G. Hinks, A. W. Mitchell and J. Jorgensen. *Phys. Rev. B (Rapid Communications)* **56**, R521 (1997) .
- *Dopant and temperature induced phase transitions in LaSrCuO by XAFS* **D. Haskel**, E. A. Stern, D. G. Hinks, A. W. Mitchell, J. Jorgensen and J. Budnick. *Phys. Rev. Lett.* **76**, 439 (1996).
- *Are Nanophase Grain Boundaries Anomalous?* E. A. Stern, R. W. Siegel, M. Newville, P. G. Sanders and **D. Haskel**. *Phys. Rev. Lett.* **75**, 3874 (1995).

SELECTED PRESENTATIONS (36 talks, 19 invited)

(Invited) *Element- and site-specific study of the atomic origin of magnetic hardness in modern magnets*, Symposium on "Combined XAS and XRD techniques in Physics, Chemistry and Materials Science", XX Congress of the International Union of Crystallography (IUCR), Florence, Italy (August 2005)

(Invited) *Hard x-ray magnetic studies at the Advanced Photon Source*. Strategic meeting of users of x-ray absorption spectroscopy at ALBA, Sevilla, Spain (October 2004).

(Invited) *Site-specific magnetism and the spin-reorientation transition in $Nd_2Fe_{14}B$ permanent magnet*. Workshop on interplay of Magnetism and Structure in Functional Materials, Benasque Center for Science, Benasque, Spain (February, 2004) .

(Invited) *Element and site-specific magnetism: X-ray studies in the absorption and diffraction channels*. Physics Colloquium, University of Nebraska, NE, USA (January, 2004) .

(Invited) *X-ray studies of Magnetism: Element Specificity and Beyond* BNL/NSLS Symposium Series, Long Island, NY, USA (May, 2003).

(Invited) *Using Circularly Polarized X-rays to study Layered Magnetic Nanostructures* Symposium on Impact of Scattering on Nanoscience and Technology, 2002 ACA Annual Meeting, San Antonio, TX, USA (2002) .

(Invited) *Dopant Structural distortions in High T_c superconductors: Active or Passive Role?* The 11th International XAFS conference (XAFS11), Ako, Japan (2000).

(Invited) *Role of Sr dopants in the inhomogeneous ground state of $La(2-x)Sr(x)CuO(4)$* Phase transitions and self organization in electronic and molecular networks, Cambridge University, Cambridge, U.K. (2000).