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RESEARCH INTERESTS AND SPECTROSCOPIES

Magnetic materials, Interplay between structure and magnetism, Magnetism at high pressures, Local structure, Phase transitions, Superconductivity, X-ray Magnetic Circular Dichroism (XMCD), X-ray Resonant Magnetic Scattering (XRMS), X-ray Absorption Fine Structure (XAFS).

CURRENT RESEARCH ACTIVITIES

Development of novel polarized x-ray techniques enabling studies of the interplay between structure and magnetism in complex, functional magnetic materials. These include extension of x-ray magnetic circular dichroism (XMCD) and polarized x-ray absorption near-edge/fine structure (XANES/XAFS) techniques to the diamond-anvil cell for high pressure studies of electronic structure and magnetism; Magnetic Reflectivity for studies of interfacial magnetic structure and depth-resolved magnetization profiles in artificial layered nanostructures, and magnetic diffraction anomalous fine structure (MDAFS) for studies of element- and site- specific magnetism in single crystalline bulk and film samples.

EMPLOYMENT/POSITIONS

Group Leader, Magnetic Materials Group Argonne National Laboratory	Jan 2013-Present
Adjunct Associate Professor of Physics, Washington University in St. Louis	June 2010-Present
Lead Scientist- Argonne National Lab	May 2006- Present
Physicist –Argonne National Laboratory	May 2005- May 2006
Assistant Physicist –Argonne National Laboratory	May 2001-May 2005
Post-doctoral Research Associate Argonne National Laboratory University of Washington	August 1999- May 2001 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: *Effect of impurities on dynamical properties of dilute metallic binary alloys*. (Advisor: Hanan Shechter)

B.Sc. in Physics

Technion, Israel

1989

RESEARCH EXPERIENCE

High pressure XMCD studies in the diamond-anvil cell: Developed a high-pressure (>1 Mbar), low-temperature (1.4 K), in-field (6.5 Tesla) capability for XANES/XMCD-studies of magnetic materials at high pressures. The instrument features a diamond-anvil cell with perforated anvils to minimize anvil's absorption, remote control of piston-motion via a gas membrane allowing *in-situ* pressure control at low temperatures and an online Ruby fluorescence system for *in-situ* pressure calibration at low temperatures. Studied pressure-induced magnetic transitions in a variety of materials including complex oxides, magneto-caloric materials and transition metals. [*Phys. Rev. Lett.* 109, 027204 (2012); *Phys. Rev. Lett.* 109, 026403 (2012); *Phys. Rev. B* (Rapid Communications) 84, 100403(R) (2011); *Phys. Rev. Lett.* 100, 045508 (2008); *Phys. Rev. Lett.* 102, 057206 (2009), *High Pressure Research* 28, 185 (2008); *Review of Scientific Instruments* 78, 083904 (2007); *Phys. Rev. B* 76, 014411 (2007)].

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 [*Phys. Rev. Lett.* **95**, 217207 (2005); *IEEE Transactions on Magnetics* **40**, 2874 (2004); *Phys. Rev. B* **73**, 144416 (2006); *Phys. Rev. B* **74**, 104114 (2006); *Appl. Phys. Lett.* 93, 052504 (2008)]. Developed a digital lock-in detection system for dichroic diffraction of CP x-rays (U.S. Patent 7,403,592 issued July 2008).

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 [*Phys. Rev. Lett.* 87, 207201 (2001); *Physical Review B* 70, 134420 (2004); *Appl. Phys. Lett.* 91, 022503 (2007); *App. Phys. Lett.* 92, 162502 (2008) *Physical Review B* 79, 134438 (2009)].

XAFS studies of the local structure of 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)].

MENTORING

Directed research work of Post-doctoral appointees (5), Graduate students (3), and visiting students (2)

2001-Present

COMPUTER EXPERTISE

Experience in FORTRAN and C scientific programming. Experience with script language programming (PERL, C-shell) as well as working knowledge of UNIX and LINUX 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

Argonne National Laboratory's Inventor Award 2009

FUNDING

Laboratory Directed Research and Development (LDRD) funding (\$980 K):

<i>Tuning electronic structure at high pressures:</i>	\$157 K	2012
<i>towards novel materials discovery from x-ray</i>	\$260 K	2011
<i>science under extreme conditions</i>	\$117 K	2010
<i>An Integrated x-ray and neutron approach</i>	\$60 K	2008
<i>to magnetic depth-profiling in nanostructures</i>	\$110 K	2007
	\$80 K	2006
<i>Site-specific magnetism in crystals</i>	\$96 K	2005
	\$100 K	2004

PATENTS

Digital Lock-in detection of site-specific magnetism in magnetic materials No. 7,403,592 2008

BOOK Chapters

Hard x-ray resonant techniques for studies of nanomagnetism, G. Srajer, J. C. Lang and D. Haskel, in *Modern Techniques for Characterizing Magnetic Materials* (Y. Zhu, Editor), Kluwer academic publishers, Chapter 5, pp. 201-227 (2005).

Review Articles

Charge-magnetic interference resonant scattering studies of ferromagnetic crystals and thin films, D. Haskel, E. Kravtsov, Y. Choi, J.C. Lang, Z. Islam, G. Srajer, J.S. Jiang, S.D. Bader, and P.C. Canfield *Eur. Phys. J. Special Topics* 208, 141-155 (2012)

OTHER ACTIVITIES

- Editorial Board Member, Scientific Reports, a Nature Journal April 2013-present
- Secretary/Treasurer of the International x-ray absorption society (IXAS) July 2012- present
- Member, Scientific Software Audit and Advisory Panel, Diamond Light Source, UK Oct 2012
- Organizer, 1st North American Core Shell Spectroscopy Conference (NACSSC) August 2010
- Neutron and x-ray scattering ANL summer school instructor (XMCD). 2002-present
- XAFS summer school instructor (XAFS and other techniques) 2005-2008
- Member General User Program spectroscopy panel (Chair 2007). 2006-2008

PROFESSIONAL ASSOCIATIONS

Member of the American Physical Society
Member of the International XAFS Society

SELECTED PUBLICATIONS (106 publications, 2530 citations, h-index=22)

Pressure Tuning of the Spin-Orbit Coupled Ground State in Sr₂IrO₄, **D. Haskel**, G. Fabbris, Mikhail Zhernenkov, P. P. Kong, C. Q. Jin, G. Cao, and M. van Veenendaal, *Physical Review Letters* 109, 027204 (2012)

Reentrant Valence Transition in EuO at High Pressures: Beyond the Bond-Valence Model
N. M. Souza-Neto, J. Zhao, E. E. Alp, G. Shen, S.V. Sinogeikin, G. Lapertot, and **D. Haskel**
Physical Review Letters 109, 026403 (2012)

Orbital magnetism and spin-orbit effects in the electronic structure of BaIrO₃
Ma. A. Laguna-Marco, **D. Haskel**, N. Souza-Neto, J. Lang, V. Krishnamurthy, S. Chikara, Gang Cao, M. van Veenendaal, *Physical Review Letters*, 105, 216407 (2010)

Pressure induced electronic mixing and enhancement of ferromagnetic order in EuX(X=O,S,Se,Te) magnetic semiconductors N. Souza-Neto, **D. Haskel**, Y.C. Tseng, G. Lapertot, *Physical Review Letters* 102, 057206 (2009).

Role of Ge in Bridging Ferromagnetism in the Giant Magnetocaloric Gd₅(Si_xGe_{1-x})₄ Alloys **D. Haskel**, Y. B. Lee, B. Harmon, Z. Islam, J. Lang, G. Srajer, Y. Mudryk, K. A. Gschneidner, V. K. Pecharsky, *Physical Review Letters* 98, 247205 (2007).

Atomic Origin of Magnetocrystalline anisotropy in Nd₂Fe₁₄B **D. Haskel**, J. Lang, Z. Islam, A. Cady, G. Srajer, M. van Veenendaal, P. Canfield, *Physical Review Letters* 95, 217207 (2005).

Enhanced Interfacial Magnetic Coupling of Gd/Fe Multilayers **D. Haskel**, G. Srajer, J. Lang, J. Pollmann, C. Nelson, J. Jiang, S. Bader. *Physical Review Letters* 87, 207201 (2001).

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. *Physical Review Letters* 76, 439 (1996).

SELECTED PRESENTATIONS (74 talks, 46 invited)

(Invited) *Pressure-tuning of the spin-orbit coupled ground state of Sr₂IrO₄*
March Meeting, American Physical Society, Baltimore, USA March 18-22 (2013)

(Invited) *X-ray absorption spectroscopy at high pressure*
Seminar, Diamond Light Source, Oxfordshire, United Kingdom (October 2012)

(Invited) *Probing Spin-Orbit interactions in BaIrO₃ with x-ray absorption spectroscopy*
Workshop on Physics driven by Spin-orbit coupling in TM compounds, IOP, CAS Beijing, China (2011)

(Invited) *Charge-Magnetic Interference hard x-ray resonant scattering studies of ferromagnetic crystals and thin films*, Resonant Elastic X-ray Scattering (REXS 2011) conference, Aussois, France (2011)

(Invited) *Squeezing Magnets- and what can we learn from it* ; Seminar, Department of Materials Physics, Universidad Complutense de Madrid, Madrid, Spain (March 2009)

(Invited) *Site-specific Magnetic Spectroscopy of Functional Materials*; 6th International Conference on Synchrotron Radiation in Materials Science (SRMS-6) Campinas, Brazil (July 2008)

(Invited) *The role of Ge in mediating FM interactions in Gd₅Si_xGe_{1-x} alloys*; Condensed Matter Physics Seminar, Instituto de Ciencia de Materiales de Aragon, University of Zaragoza, Zaragoza, Spain (March 2007)

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

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