



Valery I. Levitas

Anson Marston Distinguished Professor in Engineering
Vance Coffman Faculty Chair Professor
Department of Mechanical Engineering (second appointment)

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Education

Dr.-Eng habil Continuum Mechanics, University of Hannover, Germany, 1995

Sci Dr. Continuum Mechanics, Ins. Electronic Machinebuilding, Moscow, USSR, 1988

Ph.D. Materials Science, Institute for Superhard Materials, Kiev, USSR, 1981

M.S. Mechanical Engineering, Kiev Polytechnic Institute, Kiev, USSR, 1978

Academic Appointments

Iowa State University (2008-present)

Department of Aerospace Engineering (August 2008-present)

Department of Mechanical Engineering (August 2008-present)

Department of Material Science and Engineering (courtesy appointment, August 2008- August 2016)

- *Anson Marston Distinguished Professor in Engineering, August 2018 – present*
- Vance Coffman Faculty Chair Professor (August 2017-present)
- Schafer 2050 Challenge Professor (August 2008-August 2017)

Ames Laboratory, Division of Materials Science and Engineering (2008-present)

- *Faculty Scientist, November 2008-present*

Texas Tech University (1999-2008)

- Professor (August 2002- August 2008)
- Director, Center for Mechanochemistry and Synthesis of New Materials (October 2002-January 2007)
- Associate Professor (August 1999- August 2002)

University of Hannover, Department of Civil Engineering, Institute for Structural and Computational Mechanics, Hannover, Germany (1993-1999)

- *Research and Visiting Professor (June 1995-August 1999)*
- *Humboldt Research Fellow (April 1993-June 1995)*

Institute for Superhard Materials of the Ukrainian Academy of Sciences, Kiev, Ukraine (1978-1994)

- Leading Researcher (February 1989- August 1994)
- Senior Researcher (March 1984-January 1989)
- Leader of research group (January 1982- August 1994)
- Engineer (April 1978-July 1981) and Junior Researcher (August 1981-February 1984)

Selected Awards and Honors

- Elected to the EU Academy of Sciences, 2022
- Khan International Medal Award for outstanding contributions to the field of plasticity (2017)
- ISU Award for Outstanding Achievement in Research (2016)
- Richard von Mises Award of GAMM (Society of Applied Mathematics and Mechanics, 1998)
- International Journal of Engineering Sciences Best Paper Award (1995)
- A. von Humboldt Foundation Fellowship, Germany (1993 – 95, 2012)

Teaching

UNDERGRAD: EM 274 Statics, ME332 Engineering Thermodynamics II

GRADUATE: EM566 Phase Transformation in Elastic Materials, EM 567 Nanomechanics of Materials, EM 586 Micromechanics of Structural Changes in Materials, EM 590 Phase Field Approach, EM 585 Continuum Mechanochemistry, EM 572 Mechanics of Interface and Surface-Induced Phenomena, EM 580 Phase Transformations and Plasticity, EM 584 High Pressure Mechanics and Phase Transformations

Research

Interest Areas: ■Materials under high pressure and large plastic deformations/in situ synchrotron radiation experiments with rotational diamond anvils/phase transformations and microstructure evolution/four-scale theory and simulations (atomistic, nano- and microscale phase field, and macroscale) ■Phase field approach/phase transformations in solids, melting-solidification, twinning, dislocations, fracture, shear bands, surface- and interface-induced phenomena ■Interaction between phase transformation and plasticity ■Material instabilities under stress tensor/atomistic simulations/phase field

Sponsored Grants at ISU: \$12.1 M (\$5.0 M personal) total from 20 grants including 19 federal (NSF (7), ARO (4), ONR (4), DARPA (1), DTRA (1), DOE (1), AFOSR (1)) and 1 foreign. 4 NSF XSEDE grants for computational resources and 18 Advance Proton Sources grants for using beamline at the synchrotron radiation facilities.

Selected Publications (of 460 pubs. including 290 journals, 11 book chapters, 3 books, 11 patents; h-index (Google): 62)

1. Levitas V.I. Resolving puzzles of the phase-transformation-based mechanism of the deep-focus earthquake. *Nature Communications*, 2022, Vol. 13, 6291, 10 p.
2. Chen H., Levitas V.I., Popov D., and Velisavljevic N. Nontrivial nanostructure, stress relaxation mechanisms, and crystallography for pressure-induced Si-I \rightarrow Si-II phase transformation. *Nature Commun.*, 2022, **13**, 982 (Editor's highlight).
3. Pandey K. K. and Levitas V. I. In situ quantitative study of plastic strain-induced phase transformations under high pressure: Example for ultra-pure Zr. *Acta Materialia*, 2020, Vol. 196, 338-346. Supporting data: <https://doi.org/10.25380/iastate.12563924>
4. Levitas V.I., Kamrani M., and Feng B. Tensorial stress-strain fields and large elastoplasticity as well as friction in diamond anvil cell up to 400 GPa. *Nature PJ Computational Materials*, 2019, Vol. 5, 94, 11 pp.
5. Feng B., Levitas V.I., and Li W. FEM modeling of plastic flow and strain-induced phase transformation in BN under high pressure and large shear in a rotational diamond anvil cell. *International Journal of Plasticity*, 2019, 113, 236-254.
6. Gao Y., Ma Y., An Q., Levitas V. I., Zhang Y., Feng B., Chaudhuri J., and Goddard III W. A. Shear driven formation of nano-diamonds at sub-gigapascals and 300 K. *Carbon*, 2019, Vol. 146, 364-368.
7. Basak A., Levitas V.I. Finite element procedure and simulations for a multiphase phase field approach to martensitic phase transformations at large strains and with interfacial stresses. *Comp. Meth. Applied Mechanics and Engin.*, 2019, 343, 368-406.
8. Levitas V.I., Jafarzadeh H., Farrahic G. H., and Javanbakht M. Thermodynamically Consistent and Scale-Dependent Phase Field Approach for Crack Propagation Allowing for Surface Stresses. *International Journal of Plasticity*, 2018, 111, 1-35.
9. Levitas V.I., Esfahani S.E., and Ghamarian I. Scale-free modeling of coupled evolution of discrete dislocation bands and multivariant martensitic microstructure. *Phys. Review Lett.*, 2018, 121, 205701.
10. Zarkevich N. A., Chen H., Levitas V.I., and Johnson D. D. Lattice instability during solid-solid structural transformations under general applied stress tensor: example of Si I \rightarrow Si II with metallization. *Physical Review Letters*, 2018, 121, 165701.
11. Levitas V.I. Phase field approach for stress- and temperature-induced phase transformations that satisfies lattice instability conditions. Part 1. General theory. *International Journal of Plasticity*, 2018, Vol. 106, 164-185.
12. Levitas V.I., Chen H., and Xiong L. Triaxial-stress-induced homogeneous hysteresis-free first-order phase transformations with stable intermediate phases. *Physical Review Letters*, 2017, 118, 025701.
13. Momeni K., Levitas V.I., and Warren J.A. The strong influence of internal stresses on the nucleation of a nanosized, deeply undercooled melt at a solid-solid interface. *Nano Letters*, 2015, 15, 2298-2303.
14. Levitas V.I. and Javanbakht M. Phase transformations in nanograin materials under high pressure and plastic shear: nanoscale mechanisms. *Nanoscale*, 2014, 6, 162 - 166.
15. Levitas V.I. Phase field approach to martensitic phase transformations with large strains and interface stresses. *Journal of the Mechanics and Physics of Solids*, 2014, Vol. 70, 154-189.
16. Ji C., Levitas V. I., Zhu H., Chaudhuri J., Marathe A., Ma Y. Shear-Induced Phase Transition of Nanocrystalline Hexagonal Boron Nitride to Wurtzitic Structure at Room Temperature and Low Pressure. *Proc. Nat. Acad. Sci. USA*, 2012, 109, 19108- 12.
17. Levitas V.I. Mechanochemical Mechanism for Reaction of Aluminum Nano- and Micron-scale Particles. *Philosophical Transactions of the Royal Society A*, 2013, Vol. 371, 20120215, 14 pages.
18. Levitas V.I. and Ravelo R. Virtual Melting as a New Mechanism of Stress Relaxation under High Strain Rate Loading. *Proc. of the National Academy of Sciences of the USA*, 2012, 109, 13204-13207.

Thesis Advisor/Co-advisor and Postgraduate-Scholar Sponsor in the USA

Postgraduate-Scholar (11): K. Samani (2013-2014), O. Zarechnyy (2009-2013), N. Altukhova (2010-2011), K. Momeni (2015), A. Roy (2015), B. Feng (2015-2016), M. Javanbakht (2013-2014), K.K. Pandey (2018-2020), A. Basak (2015-2019), S. Cui (2017-2018), Z. He (2014-2015), H. Babaei (2020), F. Lin (2020-), S. Yesudhas (2020-).

Doctoral (18): K. Samani (2013), O. Zarechnyy (2009), N. Altukhova (2010), H. Attariani (2014), M. Javanbakht (2013), A. Roy (2015), K. Momeni (2015), B. Feng (2015), Y. S. Hwang (2016), D. Lee (2008), I. Ozsoy (2007), H. Chen (2018); E. Esfahani (2020), H. Babaei (2019), M. Kamrani (2020), H. Jafarzadeh (2019), B. Dikici (2010), J. Cho (2009)

Masters (3): A. Francis (2007), R. Chirumamilla (2008), A. Palakala (2008).

Professional and Outreach Activities

- International Association for Advancement of High Pressure Science and Technology: Executive Committee 1993-1999
- Member of ASME (1996- ; Fellow 2007 -), SES (1995-), TMS (2005-), AIRAPT (1987-); EUROMECH (2012-)
- Scientific Committees of International Conferences: 32
- Organized: 34 symposia at *Plasticity International conference, ASME and SES Annual meetings, etc*
- Plenary, keynote, and invited lectures at symposia: 88, including *Plasticity'19 International Symposia, ASME, SES, etc.*
- Editorial Board Member of 3 Journals: Scientific Reports; Int. J. Plasticity; J. Superhard Materials.