Nilesh Badwe, Ph.D.

Home address: FB412-B Faculty Building, Dept. of Materials Science and Engg., IIT Kanpur, Kanpur, UP - 208016, India

Phone No.: +91 512 259 2205
Email: nbadwe@iitk.ac.in

EDUCATION

- **Ph.D. in Materials Science and Engineering** (Nov 2014)
  Arizona State University (ASU) *Dissertation: Fracture of Nanoporous Gold* GPA: 4.00/4.00
- **B. Tech. in Metallurgical Engineering and Materials Science** (May 2008)
  Indian Institute of Technology, Bombay (IIT Bombay) GPA: 8.91/10.00

PROFESSIONAL EXPERIENCE

- **Assistant Professor,** IIT Kanpur (Feb 2021 - Present)
- **Staff Packaging R&D Engineer** & **Materials Technologist,** Intel Corporation (Mar 2020 - Feb 2021)
- **Packaging R&D Engineer,** Intel Corporation (Jul 2015 – Mar 2020)
- **Post-Doctoral Research Scholar,** Arizona State University (ASU) (Dec 2014 - Jul 2015)

JOURNAL PUBLICATIONS

1. Y. Fan, Y. Wu, T. Dale, S. Lakshminarayana, C. Greene, **N. Badwe**, R. Aspandiar, J. Blendell, G. Subbarayan, C. Handwerker, Influence of Pad Surface Finish on the Microstructure Evolution and Intermetallic Compound Growth in Homogeneous Sn-Bi and Sn-Bi-Ag Solder Interconnects, **Journal of Electronic Materials**, 50, 6615–6628, 2021
2. **N. Badwe,** S. Wozny, P. Daharwal, T. Rawlings, P. Diglio, M. Renavikar, P. Tadayon, High temperature fatigue and mechanical properties of electrodeposited Ni-based nanocrystalline alloys, **Materialia**, 18, 101136, 2021
3. X. Chen, E. Karasz, **N. Badwe,** K. Sieradzki, Film induced cleavage in stress corrosion cracking of single crystal AgAu alloys, **Corrosion Science**, 187, 109503, 2021
4. **N. Badwe,** X. Chen, D. Schreiber, M. Oltza, E. Karasz, A. Tse, S. Bruemmer, K. Sieradzki, De-coupling the role of stress and corrosion in the intergranular cracking of noble-metal alloys, **Nature Materials**, 17, 887–893, 2018
5. **N. Badwe,** X. Chen, K. Sieradzki, Mechanical properties of nanoporous gold in tension, **Acta Materialia,** 129, 251-258, 2017
6. **N. Badwe,** R. Mahajan, K. Sieradzki, Interfacial Fracture Strength and Toughness of Copper/Epoxy-Resin Interfaces, **Acta Materialia,** 103, 512–518, 2016
7. S. Sun, X. Chen, **N. Badwe,** K. Sieradzki, Potential dependent dynamic fracture in nanoporous gold, **Nature Materials,** 14, 894–898, 2015

CONFERENCE PROCEEDINGS

1. K. Young, **N. Badwe,** R. Aspandiar, S. Walwadkar, Y.W. Lee, T.K. Lee, Low melting temperature solder interconnect thermal cycling performance enhancement using elemental tuning, SMTA International 2022 (Accepted)
2. K. Young, R. Aspandiar, **N. Badwe,** S. Walwadkar, Y.W. Lee, T.K. Lee, Thermal cycling induced interconnect stability degradation mechanism in low melting temperature solder joints. In 2022 IEEE 72nd Electronic Components and Technology Conference (ECTC), 1199-1205, 2022

3. Y. Fan, S. Achar, C. Greene, H. Fowler, T. Dale, Y. Wu, **N. Badwe,** R. Aspandiar, J. Blendell, G. Subbarayan, C. Handwerker, Microalloying effects on intermetallic compound growth and mechanical reliability of Sn-Bi solder joints, SMTA International 2021
4. **N. Badwe,** P. Goonetilleke, R. Sidhu, J. Stafford, Thermal cycle and drop-shock performance of homogeneous LTS vs SAC solder joints, SMTA International 2020
5. Y. Fan, T. Dale, Y. Wu, **N. Badwe,** R. Aspandiar, J. Blendell, G. Subbarayan, C. Handwerker, Intermetallic Compound Growth and Gold Embrittlement Effect in Sn-Bi Low Temperature Solders in Contact with Electroless Nickel Emersion Gold (ENIG) Surface Finish, SMTA International 2020
6. **N. Badwe,** K. Byrd, O. Jin, P. Goonetilleke, Tin-Bismuth low temperature homogeneous second level interconnect solder joint microstructure, reliability, and failure mechanism, SMTA International, Chicago 2019
7. T. Harris, K. Byrd, **N. Badwe,** Root cause and solution to mitigate the hot tear defect mode in hybrid SAC-low temperature solder joints, SMTA International, Chicago 2019
8. A. Prasad, X. Chen, **N. Badwe,** K. Byrd, Low temperature solder paste transfer efficiency characterization and area ratio limits, SMTA International, Chicago 2019
9. **N. Badwe,** S. Cheng, S. Aravamudhan, M. Renavikar, Solder paste: fundamental material property / SMT performance correlation, SMTA International, Chicago 2018
10. S. Sahasrabudhe, S. Mokler, M. Renavikar, S. Sane, E. Brigham, K. Byrd, O. Jin, S. Parupalli, P. Goonetilleke, **N. Badwe,** Low temperature solder – a breakthrough technology for surface mounted devices, IEEE 68th Electronic Components and Technology Conference (ECTC), San Diego 2018

CONFERENCE/WORKSHOP PRESENTATIONS

1. **Invited talk:** N. Badwe, Evolution of Low Temperature Solders in the Recent Years, SMTA Workshop, Bangalore, 2023.
2. T. K. Lee, N. Badwe, G. Baty, R. Aspandiar, Y. W. Lee, Low melting temperature solder interconnect: Thermo-mechanical performance enhancement using elemental tuning, TMS 2023 (Accepted)
3. **Invited Talk:** K. Sieradzki, X. Chen, E. Karasz, **N. Badwe**, Dynamic fracture and dealloying induced stress-corrosion cracking, TMS 2021
4. Y. Fan, Y. Wu, T. Dale, S. Achar, H. Fowler, **N. Badwe,** R. Aspandiar, J. Blendell, G. Subbarayan, C. Handwerker, Microalloying effects on intermetallic compound growth and mechanical reliability of Sn-Bi solder joints, TMS 2021
5. **Invited Talk: N. Badwe,** Future of interconnects: hybrid vs homogeneous low temperature solder joints, Advanced Microelectronic Packaging and Emerging Interconnect Materials Workshop at TMS, San Diego 2020
6. Y. Fan, Y. Wu, J. Blendell, **N. Badwe,** C. Handwerker, A model study of Bi diffusion and intermetallic growth in Sn-Bi low temperature soldering systems, TMS, San Diego 2020
7. **Invited Talk: N. Badwe,** Low melting temperature solder and interconnects: looking back to the Bi role in Sn base solder, Electronic Packaging and Interconnect Materials Workshop at TMS, San Antonio 2019
8. **N. Badwe,** Sn-Bi solders overview: material development, Bi supply and SMT impact, LTS Symposium at SMTAI, Chicago 2019
9. **Invited Talk:** Y. Fan, Y. Wu, J. Blendell, **N. Badwe,** C. Handwerker, Thermodynamic and kinetic effects on microstructure evolution in hybrid low temperature solder/high-Sn solder joints, IEEE 6th International Workshop on Low Temperature Bonding for 3D Integration (LTB-3D), Kanazawa, Japan 2019

10. Y. Fan, Y. Wu, J. Blendell, **N. Badwe,** C. Handwerker, A model study of microstructure evolution and Bi diffusion in Sn-Bi low temperature soldering systems, MS&T, Portland 2019
11. **Invited Talk:** K. Sieradzki, **N. Badwe,** X. Chen, E. Karasz, A. Tse, Dealloying induced stress corrosion cracking, TMS, Phoenix 2018
12. X. Chen, K. Sieradzki, **N. Badwe,** Mechanical properties of nanoporous gold, MRS Spring meeting, Phoenix 2016

BOOK CHAPTER/MAGAZINE ARTICLE

1. R. Aspandiar, **N. Badwe,** K. Byrd, Low temperature lead free alloys and solder pastes, In J. Bath (Ed.), Lead-free Soldering Process Development and Reliability, John Wiley & Sons Inc publisher, (Jul 2020)
2. **N. Badwe,** K. Byrd, O. Jin, P. Goonetilleke, Tin-Bismuth low temperature homogeneous second level interconnect solder joint microstructure, reliability, and failure mechanism, Circuit Assembly Magazine, Feb 2020

ACADEMIC RESEARCH PROJECTS

- High Melt – Low Melt Solder Interconnect Structures for SMT Applications, PI: Prof. E. Cotts, Binghamton University, Semiconductor Research Corporation (SRC) (2017 – 20)
- Low temperature solder systems – Development and Fundamental Understanding, PIs: Prof. C. Handwerker, Prof. G. Subbarayan, Purdue University, Intel System Integration Strategic Research Sector (2018 – 21)
- Reliable Low Temperature Solder Approach,, PIs: Prof. Borgesen, Prof. Dimitrov, Binghamton University, CHIRP Center/Semiconductor Research Corporation (SRC) (2020 – 21)
- Development of Local Degradation Index for Thermal Cycling Joints Based on Pre-Crack EBSD Analysis, PI: Prof. Tae-Kyu Lee, Portland State University, Intel Corporation Funding (2020 – 21)
- Development of bicontinuous metallic nanocomposites through electrochemical approaches for interconnects and MEMS applications, IIT Kanpur seed grant funding, INR 25 Lakhs, (2022 -), Ongoing, PI

REVIEWER

- Acta Materialia
- Scripta Materialia
- Materials Science and Engineering A (Outstanding reviewer award)
- Journal of Alloys and Compounds
- Journal of Electronic Materials
- JOM (The Journal of The Minerals, Metals & Materials Society - TMS)
- Engineering Failure Analysis
- IEEE TCPMT
- Journal of SMT
- Intel Assembly & Test Technology Journal
- Semiconductor Research Corporation (SRC) - Grant proposals
- Intel System Integration Strategic Research Sector (SRS) - Grant proposals

ORGANIZATION/ADMINISTRATIVE

- **Associate Editor:** Microelectronics Reliability (Journal), 2021 - present
- **Organizer:** Electronics Packaging and Interconnect Materials Workshop, TMS, 2023
- **Animal walfare committee, IIT Kanpur:** Member, 2023 - present
- **Selection committee:** J. N. Tata Endowment awards, 2022

- **Committee:** Batra quiz competition, 2022
- **VP of Technical Program:** SMTA India Chapter, 2022 – present
- Departmental Software labs and Website/Social Media Committee, 2022 - present
- **Organizer:** Prof. N. K. Batra Metals and Materials Quiz, 2022
- **PMRF selection committee member,** MSE department, IITK, 2021, 2022, 2023
- **Student placement committee,** MSE department, IITK, 2021 - 2022
- **DUGC committee member,** MSE department, IITK, 2021 - 2022
- **Judge:** Students' Research Convention, IIT Kanpur, 2021
- **Technical Committee:** Surface Mount Technology Association International 2020 - present
- **Organizer:** Adv. Microelectronic Packaging & Emerging Interconnect Materials Workshop at TMS, San Diego 2020
- **Technical Committee:** TMS Electronics Packaging and Interconnect Materials 2019 - present
- **Organizer:** Low Temperature Solder Symposium, SMTA International, Chicago, 2019
- **Session Chair:** TMS, San Antonio 2019, San Diego 2020
- **Session Co-chair:** SMTA International, Chicago 2018, 2019
- **Organizer:** Materials section, ASME InterPack Workshop, San Jose 2016
- **Event Organizer:** PAN-IIT Phoenix Chapter, 2014 - 15

AWARDS/SCHOLARSHIPS

- **Teaching Excellence Certificate:** MSE658A: Dislocations and Plasticity, Fall 2021
- TMG **Excellence Award**, Intel Corporation (2018)
- ATTD **Divisional Recognition Awards**, Intel Corporation (2017, 2019)
- CQN **Divisional Recognition Awards**, Intel Corporation (2019, 2021)
- MTD **Departmental Recognition Awards**, Intel Corporation (2016, 2017, 2018, 2019, 2020)
- University Graduate Fellowship – **Arizona State University** (2008, 2012)
- Among top 3 students (out of 560) selected from IIT Bombay for **Tata steel scholarship** (2007 - 08)
- Among top 3 students from Maharashtra selected for **Hinduja merit cum means scholarship** (2001 - 08)