

## **CURRICULUM VITAE**

Name: Anandaroop Bhattacharya

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Institution: Indian Institute of Technology, Kharagpur

### **Academic Qualification (Undergraduate Onwards)**

Degree	Year	Subject	University/Institution
B. Tech. (Hons)	1997	Mechanical Engineering	Indian Institute of Technology (IIT), Kharagpur
Master of Science	1999	Mechanical Engineering	University of Colorado at Boulder, USA
Ph.D.	2001	Thermal and Fluids Sciences	University of Colorado at Boulder, USA

### **Specialization and Expertise**

Specialization: Thermal & Fluids Engineering

Research areas: Electronic Packaging and Cooling, Microscale Transport Phenomena, Flow in Porous Media, Energy Engineering, Gas Turbine Heat Transfer

### **Professional experience (in reverse chronological order)**

- Associate Professor, Mechanical Engineering Dept, IIT Kharagpur (July 2015 – present)
  - Involved in teaching and research
- Associate Dean, International Relations, IIT Kharagpur (July 2018 – present)
  - Setting the strategy for international and external outreach of the Institute
- Visiting Scholar, Waterloo Institute of Nanotechnology, Univ. of Waterloo (Summer 2018)
  - Microfluidics research in the domain of Energy Engineering
- Senior Engineer at GE Global Research Center, India (July 2012 – July 2015)
  - Led projects with business funding levels of \$500-700k per year in Energy Management, Oil & Gas, Aviation and Healthcare
  - Started new area on System Level Thermal Management across different GE businesses
- Senior Researcher at General Motors R&D - India Science Lab (August 2010 – June 2012)
  - Senior Technologist in CFD group working on Thermal Management of Electric Drives and Power Electronics
- Staff Mechanical Engineer at Intel Technology India Pvt. Ltd. (July 2005 – August 2010)
  - Technology Lead for Thermal Technology Development team for mobile platforms

- Member of the global IP committee, Mentored several university collaborations
- Assistant Professor (Mechanical Engineering) at IIT Bombay (December 2003 – July 2005)
  - Teaching and research guidance
  - Founding member of Suman Mashruwala Microsystems Lab
- Senior Mechanical Engineer at Intel Corporation, Chandler, AZ, USA (March 2002 – Nov 2003)
  - Packaging and Thermal Management of microprocessors, packages and systems
  - Mentor for university collaboration

**Professional Recognition/ Award/ Prize/ Certificate, Fellowship**

Sl. #	Name of Award	Awarding Agency	Year
1.	GE GRC Organizational Citizen Award	GE Global Research Center, India	2015
2.	GE Inventor Award - medallion	GE Global Research Center, India	2015
3.	INAE – Young Engineer Award	Indian National Academy of Engineering (INAE)	2009
4.	MPG Achievement Award – second highest technical award at Intel	Intel Corporation	2009
5.	MG-India Idol Innovation award	Intel Corporation	2009
6.	Team Excellence Award – Client Platform Engineering	Intel Corporation	2009
8.	Inclusion in America’s Registry of Outstanding Professionals	America’s Registry of Outstanding Professionals	2003
9.	Enrolment Enhancement Fellowship	Dean, School of Engineering, University of Colorado at Boulder	2001
10.	IBM Cooperative Fellowship	International Business Machines (IBM)	1998-99 1999-00
11.	Engineering Excellence Fund and Award	School of Engineering, University of Colorado at Boulder	1998-99

**TECHNOLOGY DEVELOPMENT AND TRANSFER**

1. **Grooved busbar**: New busbar design for Electrical power equipments that enable more than 20% material (copper) savings in busbars with no penalty in rating; technology implemented in GE motor control centers.
2. **Laminar Wall Jets**: a technology inspired by film cooling of gas turbine blades, whereby through an intelligent louver design, the entrained cooling airflow is redirected along the bottom side of the

notebook chassis thereby guiding the flow to precisely where it is needed. The technology was adopted by multiple computer manufacturers (Dell, HP, Acer, Lenovo) and can be found in several commercially launched systems today.

3. **Honeywell PCM 45F:** Involved in co-developing and characterizing the Thermal Interface Material (TIM) Honeywell PCM 45F that went on to be adopted by multiple computer manufacturers; also developed reliability models that are widely used in the industry today for prediction of TIM performance degradation.
4. **Chimney effect:** Developed flow channelization technology to enable fanless desktop computing systems; concept and design are seen in various embodiments in the several All-In-One (AIO) desktop systems that have come out in the last 3 years.
5. Initiated and investigated several new ideas including delta wing vortex generators, miniature piezoelectric fans, synthetic jets, new thermal interface materials (TIM), porous skins and transient cooling through PCMs. Some of these technologies are in various stages of licensing negotiations

### **SUMMARY OF RESEARCH OUTPUT (PAPERS, PATENTS, TECHNOLOGY DEVELOPMENT)**

Publication in refereed journals:	22
Publications in conferences:	25
Book Chapter:	1
Patents filed/issued:	20

### **STUDENT SUPERVISION**

Ph.D.:	11 current
M.Tech.:	11 graduated + 2 current
B.Tech.:	19 graduated + 3 current

### **MAJOR SPONSORED R&D PROJECTS COMPLETED/ON-GOING**

- “Thermal Technology Toolkit For Smart Computing Systems For IoT Applications”  
Sponsor: Intel Corporation, INR 3.5 million (2018-21)
- “Electrohydrodynamics For Avionics Cooling”  
Sponsor: GE India Industrial Pvt. Ltd., INR 2.06 million (2019-21)
- “Two Phase Mechanically Pumped Fluid Loop (MPFL) with microchannel based evaporator for application to high power communication spacecraft, interplanetary mission and human space mission”  
Sponsor: Indian Space Research Organization (ISRO), INR 3.05 million (2018-21)
- “Capacity fade and prognostics of advanced Li-ion battery”  
Sponsor: Samsung Research Institute Bangalore, INR 1.98 million (2018-20)
- “Electrothermal flows for Thermal Management of Electronics”,  
Sponsor: Dept. of Science and Technology, INR 3.2 million (2018-21)
- “Development of Scalable GaN-based Distributed Dynamic Power Management System for IoT Applications with On-Demand Dynamic Thermal Management”  
Sponsor: Ministry of HR Development – IMPRINT scheme, INR 23.8 million (2017-20)
- “Development of High Energy And High Power Density Lithium Ion Battery For Under Water Application”  
Sponsor: Ministry of HR Development – IMPRINT scheme, INR 16.1 million (2017-20)

- “Opened & Intelligent Plug-in Hybrid Electric Vehicle (PHEV) Technologies for Smart Indian Cities”  
Sponsor: Ministry of HR Development – UAY scheme with TATA Motors, INR 198.9 million (2016-19)
- “Experimental Investigation of Pool Boiling and Direct Contact Condensation in High Porosity Metal Foams”  
Sponsor: IIT Kharagpur seed grant, INR 2.7 million (2016-18)
- Led R&D projects at Intel, GM and GE during 2005 – 2015 with budgets ranging from USD 300k – 700k per year
- Part of the 6-member founding team of Suman Mashruwala Microsystems Lab at IIT Bombay  
Sponsor: Raj Mashruwala Endowment grant, USD 1 million (2004)
- Industry mentor university collaboration projects (GA Tech, IIT Bombay, IIT Kharagpur)

### **TEACHING EXPERIENCE**

- IIT Kharagpur
  - UG: Heat Transfer, Heat Transfer Lab
  - PG: Fundamentals of Electronic Packaging, Refrigeration Systems, Energy Conservation and Waste Heat Recovery, Measurements Lab
- IIT Bombay
  - UG: Heat Transfer, Fluid Mechanics and Fluid Machines
  - PG: Electronic Packaging and Manufacturing, Transport in Porous Media
- NPTEL MOOCS, Govt. of India
  - Energy Conservation and Waste Heat Recovery
  - Electronic Packaging and Manufacturing
- Industry
  - GE Edison Engineering Development Program (EEPDP) - Thermodynamics, Thermal and Flow Measurements
  - Intel University – Thermal Design and Analysis of Electronic Systems

### **VOLUNTEERING ACTIVITIES**

- Associate Editor of IEEE Transactions on Components and Packaging Technologies (2008 – present)
- Assistant Warden, Meghnad Saha Hall of Residence, IIT Kharagpur (2015-present)
- Member of MHRD - SPARC Organizing team (2018-19)
- Member of Executive Committee IEEE Kharagpur Section (2016 – present)
- Member of American Society of Mechanical Engineers (ASME), 1999-present
- Chair of Technical Tracks/Sessions/Panel Discussions
  - IEEE: ITherm 2006, 2008, 2014, 2017
  - ASME: IMECE 2009, InterPACK 2010
  - ISHMT - ASME Heat and Mass Transfer Conference 2013, 2015, 2019
- National Advisory Committee for ISHMT-ASME Heat and Mass Transfer Conference (2013, 2017)

- Program Committee for International Conference on Design and Reliability of Mechanical Systems (iCDRMS), 2015, 2016 (supported by IEEE CPMT)

## **OTHER HONORS**

- TRIZ Level 2 Certification (2013)
- Regular Reviewer for variety of journals including ASME and IEEE Journals, Journal of Applied Physics, Journal of Porous Media, Institute of Physics, etc.
- Undergraduate student awards from I.I.T. Kharagpur (1997)
  - Best Outgoing Student from Mechanical Engineering Society – for academic excellence and contribution to the department
  - Amlan Sen Memorial Award – for best sessional work in Mechanical Engineering
  - Medury Bhanumurthy Memorial Award – best graduating student from the Institute for extra-academic excellence
  - Institute Blue (Order of Merit) for Music and Dramatics

## LIST OF PUBLICATIONS AND PATENTS

### Book Chapter

1. Bhattacharya, A., Chang Je-Young, Haehn, Nicholas, "Thermal Management of Electronics using Sprays and Droplets", Applications and Paradigms of Droplet and Spray Transport: Paradigms and Applications, pp. 267-295, Springer (2018).

### Journal Publications

1. Kunti G., Bhattacharya A., Chakraborty S., "Interfacial dynamics of immiscible binary fluids through ordered porous media: The interplay of thermal and electric fields", *Physics of Fluids*, **31** (2019)
2. Kunti G., Dhar J., Bhattacharya A., Chakraborty S. "Joule heating-induced particle manipulation on a microfluidic chip", *Biomicrofluidics*, **13** (2019)
3. Kunti G., Bhattacharya A., Chakraborty S. "Alteration in contact line dynamics of fluid-fluid interfaces in narrow confinements through competition between thermocapillary and electrothermal effects", *Physics of Fluids*, **30** (2018)
4. Kunti G., Bhattacharya A., Chakraborty S., "Electrothermally actuated moving contact line dynamics over chemically patterned surfaces with resistive heaters", *Physics of Fluids* **30**, (2018)
5. Kunti G., Bhattacharya A., Chakraborty S., "Electro-thermally driven transport of a non-conducting fluid in a two-layer system for MEMS and biomedical applications" *Journal of Applied Physics*, **123** (2018)
6. Kunti G., Mondal P. K., Bhattacharya A., Chakraborty S. "Electrothermally modulated contact line dynamics of a binary fluid in a patterned fluidic environment", *Physics of Fluids* **30** (2018)
7. Kunti G., Dhar J., Bandyopadhyay S., Bhattacharya A., Chakraborty S., "Energy-Efficient Generation of Controlled Vortices on Low-Voltage Digital Microfluidic Platform" *Applied Physics Letters* **113** (2018)
8. Kunti, Golak, Bhattacharya, A., Chakraborty, S. "Alternating current electrothermal modulated moving contact line dynamics of immiscible binary fluids over patterned surfaces", *Soft Matter*, **13**, pp. 6377-6389 (2017).
9. Kunti, Golak, Bhattacharya, A., Chakraborty, S. "Numerical investigations of electrothermally actuated moving contact line dynamics: Effect of property contrasts", *Physics of Fluids* **29**, 082009 (2017).
10. Kunti, Golak, Bhattacharya, A., Chakraborty, S. "Rapid mixing with high-throughput in a semi-active semi-passive micromixer", *Electrophoresis*, **38** (9-10), pp. 1310-1317 (2017).
11. Kunti, Golak, Bhattacharya, A., Chakraborty, S. "Analysis of micromixing of non-Newtonian fluids driven by alternating current electrothermal flow", *Journal of Non-Newtonian Fluid Mechanics*, **247**, pp. 123-131 (2017).
12. Kunti, Golak, Bhattacharya, A., Chakraborty, S., "A scaling analysis for electro-thermo-hydrodynamic convection with variable thermophysical and electrical properties", *International Journal of Heat and Mass Transfer*, **109**, pp. 215-222 (2017).
13. Kavoori Nagapriya, Sinha Shashank, Prashanth R, Poonacha Samhitha, Chaudhry Gunaranjan, Bhattacharya, A., Choudhury Niloy, Mahalik Saroj, Maity Sandip, "Laser Calorimetry Spectroscopy for sub-ppm Dissolved Gas Detection and Analysis" *Scientific Reports*, **7**, 42917; doi: 10.1038/srep42917 (2017).
14. Bhattacharya, A., R. Senthil, Varadarajan, Krishnakumar, 2016, "Phase Change Materials for Transient Cooling of a Heater Array in a High Aspect Ratio Channel in Presence of Mean Flow", *ASME Journal of Thermal Science and Engineering Applications*, **8**, doi: 10.1115/1.4030696 (2016).

15. Sarangi, R.K., Bhattacharya A., and Prasher, R.S., "Numerical Modeling of Boiling Heat Transfer in Microchannels", *Applied Thermal Engineering*, **29**, pp. 300-309 (2009).
16. Mongia, Rajiv, Bhattacharya A., and Pokharna, Himanshu, "Skin Cooling and Other Challenges in Future Mobile Form Factor Computing Devices", *Microelectronics Journal*, **39** (7), pp. 992-1000 (2008).
17. Malapure, V.P., Mitra, Sushanta K., and Bhattacharya A., "Numerical Investigation of Fluid Flow and Heat Transfer over Louvered Fins in Compact Heat Exchangers", *International Journal of Thermal Sciences*, **46**, pp. 199-211 (2007).
18. Bhattacharya, A. and Mahajan, R.L., "Metal Foam and Finned Metal Foam Heat Sinks for Electronics Cooling in Buoyancy Induced Convection", *ASME Journal of Electronic Packaging*, **128**, pp. 259-266 (2006).
19. Bhattacharya, A. and Mahajan, R.L., "Temperature Dependence of Thermal Conductivity of Biological Tissues", *Physiological Measurements*, **24**, pp. 769-783 (2003).
20. Bhattacharya, A. and Mahajan, R. L., "Finned Metal Foam Heat Sinks for Electronics Cooling in Forced Convection", *ASME Journal of Electronic Packaging*, **124** (3), pp. 155-163 (2002).
21. Bhattacharya, A., Calmidi, V. V., and Mahajan, R.L., "Thermophysical Properties of High Porosity Metal Foams", *International Journal of Heat and Mass Transfer*, **45** (5), pp. 1017-1031 (2002).
22. Bhattacharya, A. and Mahajan, R.L., "Entrainment Effects in Buoyancy Induced Flows in Longitudinal Finned and Finned Metal Foam Heat Sinks", *International Journal of Microelectronic Packaging*, **1**, pp. 253-267 (2001).

## **Conference Proceedings**

1. Dash M., Kumar S. , Bandyopadhyay P. P., Bhattacharya A., "A Study On Evolution Of Splat Radius And Temperature In Thermal Spray Process" Proceedings of International Mechanical Engineering Congress and Exposition IMECE2018, 2018.
2. Ramakrishna Tupakula, Ghosh Moulic S., and Bhattacharya, A., "Experimental Study on Buoyancy Induced Convection in Open Cell Aluminum Metal Foam", Proceedings of ASME International Mechanical Engineering Congress and Exposition IMECE2017, 2017.
3. Kharangate, C., Uppal, A., Prabhu, S.V., Vedula, R.P., Reddy, Anand V., Bhattacharya, A., "Delta Wing Vortex Generators For Local Heat Transfer Enhancement In High Aspect Ratio Channels In Laminar Flows", Proceedings of the 23rd National and 1st ISHMT-ASTFE Heat and Mass Transfer Conference, ISRO Trivandrum, 2015, Paper no. IHMTC2015-1566.
4. Bhattacharya, A., R. Senthil, Varadarajan, Krishnakumar, "Phase Change Materials for Transient Cooling of a Heater Array in a High Aspect Ratio Channel in Presence of Mean Flow", Proceedings of the 22nd National and 11th International ISHMT-ASME Heat and Mass Transfer Conference, IIT Kharagpur, 2013. Paper no. HMTc 1300625.
5. Goel, Nitin, Anoop T.K., Bhattacharya, A., Cervantes, Joe, Mongia, R.K., Machiroutu, Sridhar V., et al., "Technical Review of Characterization Methods for Thermal Interface Materials (TIM)", Proceedings of IThERM, Orlando, FL, 2008, pp. 248-258.
6. Bhattacharya, A., and Mongia, R.K., "Low Profile Piezoelectric Fans for Cooling in Confined Geometries", contributed paper in *A Festschrift in Honour of Professor Suhas P. Sukhatme*, Research Publishing Services, Singapore, 2008, pp. 67-71.
7. Bhattacharya, A., Vijayaraghavan, Sanjay, and Chunduru, Sriharsha, "Cooling Challenges for Future Generation of Laptop Computers", Proceedings of the 19th National & 8<sup>th</sup> ISHMT ASME Heat and Mass Transfer Conference, Hyderabad, India, 2008, Paper no. EC-3.
8. Bhattacharya, A., Mongia, Rajiv K ., and Kamiya, R., "Laminar Wall Jets for Skin Cooling in Low Form Factor Electronics", Proceedings of THERMES, Thermal Challenges in Next Generation Electronic Systems -II, Santa Fe, New Mexico, 2007 pp. 291-298.
9. Mongia, Rajiv K., Macdonald, M.A., Mccune, Joshua S., Pavlova, Anna A., Trautman, Mark A. and Bhattacharya, A., "Heat Transfer Enhancement Using Synthetic Jets for Cooling in Low Form Factor Electronics in Presence of Mean Flow", Proceedings of the 9th Electronic Packaging Technology Conference, Singapore, 2007, pp. 830-835.
10. Singh, S.G., Duttagupta, S.P., Bhattacharya, A., and Meiti, N., "Fabrication and Characterization of Integrated Microchannel and Microheater", Proceedings of the 33rd National and 3rd International Conference on Fluid Mechanics and Fluid Power, Mumbai, India, 2006, Paper no. NCFMFP2006-1508.
11. Agrawal, Amit, Bhattacharya, A., and Agrawal, Abhishek, "Flow Patterns and Pressure Drop in different Microchannels and Microbends", Proceedings of the 18th National & 7<sup>th</sup> ISHMT ASME Heat and Mass Transfer Conference, Guwahati, India, 2006, pp. 2385-2392, Paper no. HMT-2006- C331.
12. Sarangi, R.K., Bhattacharya, A., Prasher, R.S., and Narasimhan, S., "Numerical Modeling of Boiling Heat Transfer in Microchannel Heat Sinks", Proceedings of 2005 ASME International Mechanical Engineering Congress and Exposition, Orlando, CA, 2005, Paper no. IMECE2005-80931.
13. Bahga, S.S., Bhattacharya, A., and Mahajan, R.L., "Numerical Modeling of Buoyancy Induced Convection in Finned Heat Sinks in Presence of Heated and Unheated Shrouds", Proceedings of 2005 ASME International Mechanical Engineering Congress and Exposition, Orlando, CA, 2005, Paper no. IMECE2005-80895.
14. Chavan, Niranjan S., Bhattacharya, A. and Iyer, Kannan, "Modeling of Two Phase Flow Instabilities in Microchannels", Proceedings of the 3rd International Conference on Microchannels and Minichannels, Toronto, Ontario, Canada, 2005, Paper no. ICMM2005-75048.



15. Malapure, V.P., Bhattacharya, A. and Mitra, Sushanta K., "Fluid Flow and Heat Transfer Analysis of Automotive Reactor using CFD Tools", Proceedings of 2005 ASME Summer Heat Transfer Conference, San Francisco, CA, 2005, Paper no. HT2005-72247.
16. Bhattacharya, A., "Analysis of Two Phase Forced Convection in Microchannels for Electronics Cooling", Proceedings of the First European Micro and Nano Systems Conference, 2004, pp. 137-141.
17. Mahalingam, R., Glezer, A., Bhattacharya, A., and Machiroutu, S.V., "Low Profile Synthetic Jet Cooling in Confined Geometries", Proceedings of 4th European Thermal Sciences Conference, Birmingham, UK, 2004, Paper no. MIC 4.
18. Bhattacharya, A., and Sorrell, J., "Mounting of MEMS Pressure Sensors on Catheter Guidewires used in Balloon Angioplasty", Advanced Biomedical and Clinical Diagnostic Systems, Proceedings of SPIE, Vol. 4958, 2003, pp. 235-241.
19. Bhattacharya, A., and Mahajan, R. L., "Numerical Modeling of Pressure Drop in High Porosity Metal Foams", Proceedings of 8th Joint AIAA/ASME Thermophysics and Heat Transfer Conference, St. Louis, MS, 2002, Paper no. 2002-3005.
20. Lohe, R.L., Bhattacharya, A. and Mahajan, R.L., "Longitudinal Finned Heat Sinks with Unheated and Heated Shrouds in Buoyancy Induced Convection", Proceedings of INTERPACK 2001 The Pacific RIM/ASME International Electronic Packaging Technical Conference and Exhibition, Kauai, Hawaii, 2001, Paper no. IPACK2001-15588.
21. Bhattacharya, A., Calmidi, V.V. and Mahajan, R.L., "Permeability and Inertial Coefficient of High Porosity Metal Foams", Proceedings of the 35th National Heat Transfer Conference, Anaheim, CA, 2001, Paper no. NHTC2001-20181.
22. Bhattacharya, A., and Mahajan, R. L., "Thermal Conductivity of Biological Tissues using Transient Hot Wire Technique", Thermal Treatment of Tissue: Energy Delivery and Assessment, Proceedings of SPIE, Vol. 4247, 2001, pp. 171-180.
23. Bhattacharya, A., and Mahajan, R. L., "Buoyancy Induced Convection in Metal Foam and Finned Metal Foam Heat Sinks", ASME Proceedings of IMECE 2000, HTD Vol. 3664, 2000, pp. 391- 98.
24. Bhattacharya, A. and Mahajan, R. L., "Finned Metal Foam Heat Sinks for Electronics Cooling in Forced Convection", Proceedings of the 34th National Heat Transfer Conference, Pittsburgh, PA, 2000, Paper no. NHTC2000-12256.
25. Bhattacharya, A., Calmidi, V. V., and Mahajan, R.L., "An Analytical Experimental Study for the Determination of the Thermal Conductivity of High Porosity Metal Foams", Application of porous media methods for engineered materials, AMD Vol. 233, 1999, pp. 13-20.

## Patent Filings

Sl. #	Patent Title	Name of Applicant(s)	Patent / Application No.	Award Year	Agency, Country
1.	ENHANCED HEAT EXCHANGER	Himanshu Pokharna, <u>Anandaroop Bhattacharya</u>	6,958,912	2005	USPTO, USA
2.	ELECTRONIC PACKAGE WITH THERMALLY-ENHANCED LID	Anandaroop Bhattacharya, Varaprasad V. Calmidi, Sanjeev B. Sathe	7,183,642	2007	USPTO, USA
3.	THERMAL MANAGEMENT ARRANGEMENT FOR STANDARDIZED PERIPHERALS	<u>Anandaroop Bhattacharya</u> , Chia-pin Chiu, Sridhar Machiroutu	7,251,139	2007	USPTO, USA
4.	ELECTROMAGNETIC INTERFERENCE SHIELDING FOR DEVICE COOLING	Rajiv Mongia, <u>Anandaroop Bhattacharya</u>	7,764,514	2010	USPTO, USA
5.	METHOD AND APPARATUS FOR INVERTED VORTEX GENERATOR FOR ENHANCED COOLING	<u>Anandaroop Bhattacharya</u> , Rajiv Mongia, Krishnakumar Varadarajan, Rajendra Vedula, Siddini V Prabhu	7,983,045	2011	USPTO, USA
6.	CHIMNEY-BASED COOLING MECHANISM FOR COMPUTING DEVICES	<u>Anandaroop Bhattacharya</u> , Mark Macdonald, Sanjay Vijayaraghavan	8,451,604	2013	USPTO, USA
7.	METHOD, APPARATUS AND COMPUTER SYSTEM FOR VORTEX GENERATOR ENHANCED COOLING	<u>Anandaroop Bhattacharya</u> , Rajiv Mongia, Krishnakumar Varadarajan	8,537,548	2013	USPTO, USA
8.	CURRENT CARRYING SYSTEMS AND METHODS OF ASSEMBLING THE SAME	Peter Greenwood, Michael Bryant, Shyam Mathure, Venkateswara Rao Polineni, <u>Anandaroop Bhattacharya</u> , Subhashish Dasgupta, Sunil Murthy	9,431,782	2016	USPTO, USA
9.	ELECTRICAL EQUIPMENT AND A METHOD OF MANUFACTURING	<u>Anandaroop Bhattacharya</u> , Subhashish Dasgupta, Peter Greenwood, Steven Meiners	9,622,374	2017	USPTO, USA
10.	CURRENT CARRYING SYSTEMS AND METHODS OF ASSEMBLING THE SAME	Peter Greenwood, Michael Bryant, Shyam Mathure, Venkateswara Rao Polineni, <u>Anandaroop Bhattacharya</u> , Subhashish Dasgupta, Sunil Murthy	10,027,076	2018	USPTO, USA
11.	ACTIVE VENTS FOR COOLING OF COMPUTING DEVICES	<u>Anandaroop Bhattacharya</u> , Bijendra Singh	20100167636	2010	USPTO, USA
12.	HIGH PERFORMANCE SPREADER FOR LID COOLING APPLICATIONS	Rajiv Mongia, Krishnakumar Varadarajan, <u>Anandaroop Bhattacharya</u>	20090323276	2009	USPTO, USA
13.	THERMAL ATTACH FOR ELECTRONIC DEVICE COOLING	Nitin Goel, <u>Anandaroop Bhattacharya</u> , Rajiv Mongia	20090127701	2009	USPTO, USA

14.	METHOD, APPARATUS AND COMPUTER SYSTEM FOR AIR MOVER LID COOLING	Krishnakumar Varadarajan, <u>Anandaroop Bhattacharya</u>	20090080157	2009	USPTO, USA
15.	WINGED PIEZO FAN	<u>Anandaroop Bhattacharya</u> , Rajiv Mongia	20080218968	2008	USPTO, USA
16.	AERODYNAMIC MEMORY MODULE COVER	<u>Anandaroop Bhattacharya</u> , Chia-pin Chiu	20050196904	2005	USPTO, USA
17.	THERMAL MANAGEMENT DEVICE FOR AN INTEGRATED CIRCUIT	<u>Anandaroop Bhattacharya</u> , Ravi S. Prasher, Jerome Garcia, Suzana Prstic	20050111188	2005	USPTO, USA

2 more under review (details not in public domain yet)