a. Complete bio-data of the applicant (not to exceed 3000 words)

Curriculum Vitae: Sangita Mukhopadhyay, PhD, FNA, FASc, FNASc, FTASc

1. Name: SANGITA MUKHOPADHYAY **Sex (M/F):** FEMALE

2. Present Position: Staff Scientist – VII and Group Leader,

3. Address (Official)
Laboratory of Molecular Cell Biology,
Centre for DNA Fingerprinting and Diagnostics,
Inner Ring Road, Uppal
Hyderabad - 500039. India.
Tel: 91-40-27216134 (O); Mobile: 09490751094
E-mail: sangita@cdfd.org.in

4. Date of birth: 1st January, 1966

5. Academic M.Sc (Botany), Burdwan University, West Bengal (1991)
PhD (Life Sciences), RMRC, Utkal University, Orissa (1996)
Post Doc (Immunology), NII, New Delhi, India, 1997-1999 and UTHSC, Houston, USA, 2005-2006

6. Research Experience: 25 years

7. Position and Employment

Sr No.	Institution Place	Position	From (Date)	To (date)
1.	Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Staff Scientist - VII	July 2019	Till date
2.	Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Staff Scientist - VI	April 2014	June, 2019
3.	Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Staff Scientist - V	April, 2010	April, 2014
4.	Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Staff Scientist - IV	August, 2005	April, 2010
5.	Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Staff Scientist - III	August, 2000	August, 2005
6.	Central Drug Research Institute, Lucknow	Scientist C	October, 1999	August, 2000

8. Professional recognition/Awards/Honors Received

1. **Best poster award** by `Indian Immunology Society & Symposium on Immunoparasitology', India, 2002;
2. **Young Scientist Award** by Department of Science and Technology, 2003;
3. **Third World Women Scientist Grant Award** by TWAS, Italy, 2003;
4. **Young Women Bioscientists of Promise Award**, 2004;
5. **National Young Woman Bioscientist Award** by DBT; 2007
6. **National Bioscience Award for Career Development**, 2008; by DBT,
7. **Kshanika Oration Award**, 2009 by Indian Council of Medical Research (ICMR);
8. **Basanti Devi Amir Chand Prize**, 2011 by ICMR;
9. **Elected member of American Association of Immunologists,** USA, 2010,
10. **Fellow of the National Academy of Sciences of India**, 2010,
11. **Fellow of the Indian Academy of Sciences, Bangalore**, 2013;
12. **ICMR Chaturvedi Ghanshyam Das Jaigopal Memorial Award**, 2015;
13. **Fellow of the Indian National Science Academy, New Delhi**, 2016
14. **Member of the Guha Research Conference** (GRC), 2016
14. **Fellow of the Telangana Academy of Sciences, Telangana**, 2016,
15. **TATA Innovation Fellowship** 2017-2018, DBT.

9. Current Research interests

Development of effective therapeutics and vaccines against tuberculosis (TB) has been one of the priority areas of global biomedical research. Understanding the mechanism of pathogenesis of tuberculosis is obligatory for identification of suitable drug target and candidate TB vaccines. Keeping this in mind, Dr. Mukhopadhyay's basic research at CDFD includes understanding how the signaling pathways are involved in modulation of protective immune response that dictates the outcome of an infection. This basic research is further translated into applied research in designing drugs and better therapeutic interventions to treat tuberculosis and oxidative stress condition. She has also designed novel biological molecules to treat inflammation and tissue injury and to promote scar-less wound healing better than the standard market drug.

Translational Potential

a. Application of antioxidants to boost immune system to control various pathophysiological disorders including tuberculosis

b. Designing of novel drugs against tuberculosis

c. Designing of therapeutics to control inflammation and wound-healing

Societal Relevance

There is an urgent need for developing effective therapeutic drug to control the menace. Understanding the molecular etiology of bacterial virulence and its interaction with the host is necessary to identify suitable drug target. Targeting bacterial virulence factors and/or cell-to-cell signalling pathways is thought to be more rational than traditional antibiotic-based therapies. In this context, Dr Mukhopadhyay has made seminal contributions to understand the mechanism of pathogenesis of inflammatory disease as well as infectious disease like tuberculosis. This basic research laid an excellent foundation for carrying out further translational research to design better and efficacious drugs and therapeutic interventions to control tuberculosis. In addition, she is striving to design novel drugs to treat scar-less wound healing and tissue inflammation which has important impact on drug market (**Media Highlight**s 1. https://www.thehindu.com/sci-tech/health/novel-mechanism-may-lead-to-better-tb-control/article6764393.ece and 2. http://vigyanprasar.gov.in/isw/A-new-boost-to-anti-tb-crusade.html)

10. Members of Scientific/Societies/other Professional bodies:

1) **Member of Sectional Committee – IX, INSA,** New Delhi

2) **Member of the CSIR Medical Sciences Research Committee**

3) **Committee member** of 2020 and 2021 Inspiring Science Awards

4) **Expert Member** of Assessment Committee of CCMB, Hyderabad

5) **Member of Scientific Advisory Committee** of NIBMG, Kalyani, W. Bengal

6) **Reviewer** of DBT Projects

7) **Committee member of INSA JRD-TATA** Fellowship Programme

8) **Committee member of INSA Medal** for Young Scientists

9) **Committee member of INSPIRE Faculty Fellowship Scheme**, Life Sciences Biomedical

10) **Selection Committee member** of Scientist performance of NIAB, Hyderabad

11) **Reviewer of CSIR FIRST Scheme**

12) **Member of DST-WOS-A**, Govt of India, 2016 – 2019

13) **Elected member of Guha Research Conference**

14) **RAP-SAC Member of NCCS, Pune**, 2015, 2016

15) **Reviewer of Dr. D. S. Kothari Postdoctoral Fellowship Scheme** of the University Grants Commission

16) **Member of Research Progress Committee**, Nirma University, Ahmedabad,

Gujarat, 2014-2016.

17) **Member of DBT Task Force** (Infectious Disease), 2014-2018

18) **Member of** Twinning R&D program for NER (Medical Biotechnology),

19) **Expert Member DST Inspire**

20) **Elected member of American Society of Hematology**, USA

21) **Elected member of American Association of Immunologists**, USA

22) **Indian Science Congress Association, India** (Life member)

23) **Indian Immunology Society, India** (Life member)

24) **Molecular Immunology Forum, India** (Life Member)

25) **Fellow of the National Academy of Sciences of India**, 2010,

26) **Fellow of the Indian Academy of Sciences, Bangalore**, 2013

27) **Fellow of the Indian National Science Academy, New Delhi**, 2016

28) **Fellow of the Telangana Academy of Sciences, Telangana**, 2016

29) **Board member of LVPEI, Hyderabad**

30) **Reviewer of CSIR SKM Fellowship program**

11. A brief statement of major scientific achievements.

The main aim of Dr. Mukhopadhyay's research is to focus Host-directed immunotherapy in tuberculosis. She made active collaboration with Hospitals and Medical Institutes for understanding mycobacterial pathogenesis designing of diagnostic marker in tuberculosis. She has also designed a novel molecule to reduce inflammation/tissue injury and to heal wound with minimum scar (***filed Indian and USA patent***). She made seminal contributions to understand how the innate and adaptive (Th1/Th2) pathways of host are hijacked by some of the mycobacterial proteins like ESAT-6, PknG and PE/PPE family proteins (PPE2, PPE18) to downregulate host-defense mechanisms and are proved to be important drug targets. While ESAT-6 inhibits class-I and lipid antigen presentation by directly interacting with beta-2 microglobulin (β2M) (***PLoS Pathog[2014] 10:e1004446***), PknG inhibits phagosome-lysosome fusion by targeting the Rab7l1 signaling (***J. Immunol [2018]201:1421***). The other protein, PPE18 activates IL-10 cytokine production and Th2 T-cell proliferation and inhibits class II antigen presentation targeting the TLR2-LRR 11~15 domain (***J. Immunol[2009]183:6269; J. Immunol[2011]186:5413; J. Biol. Chem[2012]287:16930***; ***J. Immunol[2016]197:1776; Eur. J. Immunol[2020]51:603***) that supports survival and replication of *M. tuberculosis* in host as mice infected with bacteria lacking *ppe18* had lower bacterial load and significantly improved survival rates compared to mice infected with the wild-type bacteria (***PLoS ONE[2012]7:e52601***). Also she showed involvement of ESAT-6, PPE18 and PPE2 in pathogenesis of tuberculosis in patients. Dr. Mukhopadhyay has

identified novel targets to block the excess IL-10/Th2 response with an aim to improve the protective anti-*M. tuberculosis* Th1 immune responses in host. Also her approach of designing of small molecule inhibitors to block ESAT-6-β2M is useful to improve CD8+ T cell responses and HFE-mediated iron regulation of host which is important to directly kill the *M. tuberculosis*-infected cells (***J. Immunol[2019]203:1918***). Another important finding of Dr. Mukhopadhyay reveals that PPE2 protein harboring a nuclear localization signal and DNA-binding motif is able to translocate to nucleus where it interacts with GATA-binding site overlapping with the TATA-box of iNOS promoter and inhibits nitric oxide production (***Sci. Rep[2017]7:39706***). The protein is also shown to inhibit NADPH activity and ROS production by directly interacting with one of the NADPH components, $p67^{phox}$ (***J. Immunol[2019]203:1218***). **An USA patent has been granted in 2013** focusing PPE2 as new drug target of tuberculosis. Importantly, discovery of the anti-inflammatory signaling of PPE18 was further translated into development of novel therapeutics to treat septicemia (***Filed Indian patent, 2016; J. Immunol[2018]200:3587***). She indicated PPE17 as a novel diagnostic marker in tuberculosis that can be used to detect latent TB cases (***PLoS ONE[2018]13:e0207787; PLoS ONE[2017]12:e0179965***). She has also designed a novel biological molecule which inhibits mast cells and thus can be successfully used to treat inflammation/ tissue injury and scar less wound (***National and International Patent filed in 2020; Manuscript in revision in EMBO Molecular Medicine***). She has published 62 research papers and about 12 papers are having more than 50 citations. Her research has tremendous potential in designing therapeutic immunomodulators to improve immune status during *M. tuberculosis* infection and inflammation. Based on her translational approach in anti-Tuberculosis drug designing, she has been awarded the prestigious TATA Innovation Fellowship of DBT, Govt of India.

12. Total Number of Publications: 62
(http://www.cdfd.org.in/labpages/sangita_publications.html)

Total Citations: 2522, h-index: 23 (as per Google Scholar)

Best 20 publications

1. Pal R and **Mukhopadhyay S***. PPE2 protein of *Mycobacterium tuberculosis* affects myeloid hematopoiesis in mice (2021). ***Immunobiology*** 226: 152051 (Impact factor – 3.18).

2. Jha V, Pal R, Kumar D and **Mukhopadhyay S***. ESAT-6 protein of *Mycobacterium tuberculosis* increases holotransferrin-mediated iron uptake in macrophages by downregulating surface hemochromatosis protein HFE (2020). ***Journal of Immunology*** 205: 3095-3106. (Impact factor – 5.06)

3. Dolasia K, Nazar F amd **Mukhopadhyay S***. *Mycobacterium tuberculosis* PPE18 protein inhibits MHC class II antigen presentation and B cell response in mice (2021). ***European Journal of Immunology*** 51:603-619. (Impact factor – 5.179)

4. Jha V, Rao RN, Janardhan S, Raman R, Sastry GN, Sharma V, Rao JS, Kumar D and

Mukhopadhyay S*. Uncovering structural and molecular dynamics of ESAT-6:β2M interaction: Asp53 of human β2-microglobulin is critical for the ESAT-6:β2M complexation (2019). ***Journal of Immunology*** 203: 1918-1929 (Impact factor – 5.06)

5. Srivastava S, Battu MB, Khan MZ, Nandicoori VK, **Mukhopadhyay S***. *Mycobacterium tuberculosis* PPE2 protein interacts with p67(phox) and inhibits reactive oxygen species production (2019). ***Journal of Immunology*** 203: 1218-1229 (Impact factor – 5.06)

6. Pradhan G, Shrivastva R and **Mukhopadhyay S***. Mycobacterial PknG targets the Rab7l1 signaling pathway to inhibit phagosome-lysosome fusion (2018). ***Journal of Immunology*** 201: 1421-1433. (Impact factor – 5.06)

7. Ahmed A, Dolasia K and **Mukhopadhyay S***. *Mycobacterium tuberculosis* PPE18 protein reduces inflammation and increases survival in animal model of sepsis (2018). ***Journal of Immunology*** 200: 3587-3598. (Impact factor – 5.06)

8. Bhat KH, Srivastava S, Kotturu SK, Ghosh S and **Mukhopadhyay S***. The PPE2 protein of *Mycobacterium tuberculosis* translocates to host nucleus and inhibits nitric oxide production (2017). ***Scientific Reports*** 7: 39706. (Impact factor – 4.379)

9. Udgata A, Qureshi R and **Mukhopadhyay S***. Transduction of functionally contrasting signals by two mycobacterial PPE proteins downstream of TLR2 receptors (2016). ***Journal of Immunology*** 197: 1776-1787. (Impact factor – 5.06)

10. Singh P, Rao RN, Reddy JR, Prasad RB, Kotturu SK, Ghosh S and **Mukhopadhyay S***. PE11, a PE/PPE family protein of *Mycobacterium tuberculosis* is involved in cell wall remodeling and virulence (2016). ***Scientific Reports*** 6: 21624. (Impact factor – 4.379)

11. Sreejit G, Ahmed A, Parveen N, Jha V, Valluri VL, Ghosh S and **Mukhopadhyay S***. The ESAT-6 protein of *Mycobacterium tuberculosis* interacts with beta-2-microglobulin (β2M) affecting antigen presentation function of macrophage (2014). ***PLoS Pathogens*** 10: e1004446. (Impact factor – 6.218)

12. Parveen N, Varman R, Nair S, Das G, Ghosh S and **Mukhopadhyay S***. Endocytosis of *Mycobacterium tuberculosis* heat shock protein 60 is required to induce interleukin-10 production in macrophages (2013). ***Journal of Biological Chemistry*** 288: 24956-24971. (Impact factor – 4.238)

13. Bhat KH, Ahmed A, Kumar S, Sharma P and **Mukhopadhyay** S*. Role of PPE18 protein in intracellular survival and pathogenicity of *Mycobacterium tuberculosis* in mice (2012). ***PLoS ONE*** 7: e52601. (Impact factor – 2.7)

14. Bhat KH, Chaytanya CK, Parveen N, Varman R, Ghosh S and **Mukhopadhyay S***. Proline-proline-glutamic acid (PPE) protein Rv1168c of *Mycobacterium tuberculosis* augments transcription from HIV-1 long terminal repeat promoter. (2012). ***Journal of Biological Chemistry*** 287: 16930-16946. (Impact factor – 4.238)

15. Nair S, Pandey AD and **Mukhopadhyay S***. The PPE18 protein of *Mycobacterium*

tuberculosis inhibits NF-κB/rel-mediated proinflammatory cytokine production by upregulating and phosphorylating suppressor of cytokine signaling 3 protein (2011). ***Journal of Immunology*** 186: 5413-5424. (Impact factor – 5.06)

16. Alam K, Ghousunnissa S, Nair S, Valluri VL, and **Mukhopadhyay S***. Glutathione-redox balance regulates c-rel-driven IL-12 production in macrophages: possible implications in antituberculosis immunotherapy (2010). ***Journal of Immunology*** 184: 2918-2929. (Impact factor – 5.06)

17. Nair S, Ramaswamy PA, Ghosh S, Joshi DC, Ghosh S, Pathak N, Siddiqui I, Sharma P, Hasnain SE, Mande SC and **Mukhopadhyay S***. The PPE18 of *Mycobacterium tuberculosis* interacts with TLR2 and activates IL-10 induction in macrophage (2009). ***Journal of Immunology*** 183: 6269-6281. (Impact factor – 5.06)

18. Khan N, Alam K, Mande SC, Valluri VL, Hasnain SE and **Mukhopadhyay S***. *Mycobacterium tuberculosis* heat shock protein 60 modulates immune response to PPD by manipulating the surface expression of TLR2 on macrophages (2008). ***Cellular Microbiology*** 10: 1711-1722. (Impact factor – 4.41)

19. Boddupalli CS, Ghosh S, Rahim SS, Nair S, Ehtesham NZ, Hasnain SE and **Mukhopadhyay S***. Nitric oxide inhibits interleukin-12 p40 through p38 MAPK-mediated regulation of calmodulin and c-rel (2007). ***Free Radical Biology and Medicine*** 42: 686-697. (Impact factor – 6.17)

20. Khan N, Rahim SS, Boddupalli CS, Ghousunnissa Padma SS, Pathak N, Thiagarajan D, Hasnain SE and **Mukhopadhyay S***. Hydrogen peroxide inhibits IL-12 p40 induction in macrophages by inhibiting c-rel translocation to the nucleus through activation of calmodulin protein (2006). ***Blood*** 107: 1513-1520. (Impact factor – 16.6)

***Corresponding author**

List of books/chapters in books published – 2

List of Review papers published - 14

Total No of Patents filed – 2 and granted - 1

i) Mukhopadhyay S, Pal R and Battu MB. Therapeutic composition for Inflammation/Tissue Injury.
Indian Patent has been filed on January 7, 2020 (Priority date – January 8, 2019);
Patent No. 201941000876
The US patent application has been filed on January 8, 2020 at the US Patent Office (USPTO) and the application number accorded is '16737012'.

ii) Mukhopadhyay S. and Ahmed A. A novel therapeutic for treatment of sepsis. Indian patent Application No. 201641002980. Date of Filing - January 27, 2016

iii) S. Mukhopadhyay, K. H. Bhat and N. Khan. A novel protein as potential candidate for development of anti-tuberculosis therapeutics (USA Patent awarded). US Patent Application Number: 12/551,115; Invention ID: IN-000044-02-US-REG Patent No:

US-8603739B2 Date of grant: December 10, 2013

Media Highlights

1.https://www.thehindu.com/sci-tech/health/novel-mechanism-may-lead-to-better-tb-control/article6764393.ece

2. http://vigyanprasar.gov.in/isw/A-new-boost-to-anti-tb-crusade.html

13. List of important national/international projects under taken.

a. Completed – 16

b. Ongoing – 5

Completed projects (last 5 years)

a.1) Project Title: Signaling pathways involved in downregulation of proinflammatory responses by PPE18 protein of *Mycobacterium tuberculosis*: implication of PPE18 as therapeutics (File No. SR/SO/HS/0120/2010)
Principal Investigator
Funding agency: Department of Science and Technology, Govt of India
Duration: 2012 – 2015; **Grant size:** Rs 41.90 lakhs

a.2) Project Title: Modulation of host immune responses by a PPE protein of *Mycobacterium tuberculosis*: Understanding its role in host-pathogen cross-talk (BT/PR5496/MED/29/512/2012)
Principal Investigator
Funding agency: Department of Biotechnology (DBT), Govt of India
Duration: 2013-2016; **Grant size:** Rs 70.00 lakhs

a.3) Project Title: Investigating potential of *Mycobacterium tuberculosis* protein PPE18 encapsulated nanoparticle as therapy for microbial sepsis (No BT/PR11605/NNT/28/758/2014)
Principal Investigator (Co PI: Prof. Anand Kondapi and Dr. Sudip Ghosh)
Funding agency: Department of Biotechnology (DBT), Govt of India
Duration: 2016 - 2018; **Grant size:** Rs 49.14 lakhs

a.4) Project Title: Molecular and biophysical characterization of the ESAT-6:β2M complex and its effect on intracellular iron concentration and macrophage anti-mycobacterial effector responses (No EMR/2016/000644)
Principal Investigator
Funding agency: Department of Science and Technology, Govt of India
Duration: 2016 – 2019; Grant size: Rs 38.57 lakhs

a.5) Project Title: Virtual Centre of Excellence on multidisciplinary approaches aimed at interventions against *Mycobacterium tuberculosis* (BT/PR12817/COE/34/23/2015), **Phase II**
Co-Principal Investigator
Funding agency: Department of Biotechnology (DBT), Govt of India
Duration: 2015 – 2020; **Grant size:** Rs 49.91 lakhs

b. Ongoing projects

b.1) Project Title: Approaching *Mycobacterium tuberculosis* PPE protein Rv1168c (PPE17) as a potential marker for diagnosis of Tuberculosis (TB) patients in India (BT/PR20669/MED/29/1072/2016)
Principal Investigator
Department of Biotechnology (DBT), Govt of India
Duration: 2018 - 2021; **Grant size:** Rs 45.22 lakhs

b.2) Project Title: Inhibition of TLR2-PPE18 interaction as novel therapeutic to improve the Th1-based anti- TB protective response of the host (BT/HRD/35/01/03/2018)
Principal Investigator
Funding agency: Tata Innovation Fellowship, Department of Biotechnology (DBT)
Duration: 2018 – 2022; Grant size: Rs 36.00 lakhs

b.3) Project Title: Understanding the role of Chorismate mutase in mycobacterial virulence (27(0364)/20/EMR-II)
Principal Investigator
Funding agency: Council of Scientific and Industrial Research (CSIR), Govt of India.
Duration: 2020 – 2023; **Grant size:** Rs 32.84 lakhs

b.4) Project Title: Studying the efficacy of PPE2 protein in the treatment of inflammation and tissue injury (BT/PR35722/BRB/10/1837/2019)
Principal Investigator
Funding agency: Department of Biotechnology (DBT), Govt of India
Duration: 2021-2024; **Grant size:** Rs 57.952 lakhs (Funds yet to receive)

b.5) Project Title: Deciphering the mechanism of *Mycobacterium tuberculosis* secretory protein PknG in Rab7l1 GTPase activity and understanding the immunomodulatory role in phagosome maturation (CDG/2019/000239)
Principal Investigator
Funding agency: DST-SERB, Govt of India.
Duration: 2019 – 2022; **Grant size:** Rs 55.19 lakhs

14. Mentorship provided to Students:

i) Research scientist/Project Associate/Project Assistant: 15

ii) Summer Research Fellows and Project assistants: 25

iii) PhD Students (Degree Awarded/Ongoing): 21

15. Other Relevant Information:

Dr Mukhopadhyay received several prestigious National awards/honors as well as International membership (USA) and Prestigious Academy Fellows (India). Students of her group received several prestigious National and International awards like INSA Medal for Young Scientists, Best Oral Presentation Award at FIMSA 2012, Young Scientist Award (2013) by the Andhra Pradesh Akademy of Sciences, GP Talwar Young Scientist Award and best poster/oral awards as well as Travel Grant award to many students and Post Doctorate Fellows of her group. She is regularly publishing in peer reviewed international journals with high impact factors as well as filed patent. She is also involved in coordinating several activities/ responsibilities of CDFD regularly as well as other committees like DBT, DST-INSPIRE, CSIR, DST WOS-A, Nirma University, Ahmedabad, University of Hyderabad, Indo-Taiwan project, CSIR SKM Fellowship, DSKPDF program etc. She is also actively involved in giving seminars and talks in various National and International Conferences and Workshops. She is a peer reviewer of various journals and grant reviewers of DBT, DST and CSIR.

Signature:

Name: Sangita Mukhopadhyay

Date: 24.09.2021

Dr. SANGITA MUKHOPADHYAY
Staff Scientist-VII and Group Leader
Laboratory of Molecular Cell Biology
Centre for DNA Fingerprinting and Diagnostics
Uppal, Hyderabad-500 039, India.