INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : **Bibrita Bhar**

Roll Number : **186106002**

Programme of Study : **Ph.D.**

Thesis Title: **Bioengineered Silk Based 3D Matrices for Skin Regeneration and In Vitro Screening Applications**

Name of Thesis Supervisor(s) : **Prof. Biman B. Mandal**

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SHORT ABSTRACT

Skin tissue serves as a critical protective barrier of our body against external factors, including pathogens, as well as thermal, mechanical, and chemical influences. The tissue is susceptible to various injuries, ranging from minor cuts and burns to chronic wounds, including diabetic ulcers and pressure sores. The non-healing chronic wounds pose a significant threat as they lose their self-repair ability and may lead to severe consequences if not treated timely. To address this urgent issue, we developed pro-regenerative matrices to meet the growing demand. This thesis presents possible silk-based strategies for fabricating matrices with inherent properties to support the growth of skin cells and accelerate regeneration. The developed silk-based hydrogel systems contained different biological molecules including extracellular matrix and phytochemicals which acted as instructive biochemical cues to accelerate the healing process. In addition, a breathable electrical bandage patch was developed as an active secondary dressing alongside the SF hydrogel. The patch provided low-intensity electrical pulses to the wound site through a silk-based antimicrobial ionogel interface. The promising outcomes of the *in vitro* and *in vivo* validations indicate immense translational potential of developed technologies for wound care. Further, reinforcing the understanding of the unique properties of SF hydrogel, the final objective focused on synthesizing a photopolymerizable SF-bioink for bioprinting. The formulation was utilized to fabricate a pre-clinical 3D bioprinted immunocompetent skin model which effectively classified skin irritative and non-irritative substances, thus establishing itself as a suitable rapid screening platform for skin sensitization tests. Therefore, along with SF-based regenerative strategies, the innovative technology of developing 3D skin models, demonstrated in the thesis, possess great promise for significant advancement in wound care technology and *in vitro* skin tissue modelling.