INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: **Applications of Reconstructed Nanofluidic Membrane of Layered Materials in Ionic Thermoelectricity and Moisture-Electricity-Generation**

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SHORT ABSTRACT

This PhD thesis focuses on the development of innovative ionic thermoelectric (i-TE) materials and moisture-electric generators from the reconstruction of layered materials. The first study explores clay-based i-TE materials, where exfoliated and surface-functionalized lamellar clay nanosheets are fabricated. These materials exhibit improved thermoelectric properties, high-temperature stability (up to 300°C), and water-assisted healing capabilities. The devices can convert waste heat and sunlight into electricity, with enhancements made by integrating photothermal materials like carbon nanotubes and hydrogel coatings for improved performance in low-humidity environments. The second study investigates V_2O_5-based i-TE materials, where the Seebeck coefficient is significantly enhanced by intercalating poly(4-styrenesulfonic acid) (PSS) into the lamellar structure. These materials maintain thermal stability, even at high temperatures, and demonstrate strong thermoelectric behavior. The third work focuses on a β-$Ni(OH)_2$ nanofluidic platform that enables both cation and anion thermodiffusion, generating

thermovoltages up to 1 V. By tuning the system with different ion-generating species, the platform offers a flexible approach to energy harvesting. The final study presents a bilayer moisture-electric generator (BMEG) assembled from vanadium pentoxide and β-nickel hydroxide membranes. This BMEG delivers continuous power output for extended periods, operates in extreme temperature conditions (-195 to +200°C), and can be rejuvenated after prolonged use. These works collectively demonstrate the potential of i-TE materials and BMEG for sustainable energy conversion technologies.