INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Rahul Patwa
Roll Number	:	1 2 6 1 0 7 0 3 0
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Name of Thesis Supervisor(s)	:	Dr. Vimal Katiyar & Dr. Amit Kumar
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SHORT ABSTRACT

Novel discotic crystalline silk nano-discs (CSNs) are prepared from waste Muga silk through acid-hydrolysis for upconversion of 'waste to wealth'. The average diameter and thickness is 49.1±12 nm and 3.1±0.9 nm, respectively. Furthermore, CSNs are modified using iron-oxide nanoparticles to fabricate magnetic CSNs (MGCSNs) through reduction reaction. CSNs reinforcement in the poly(lactic acid) (PLA) matrix to fabricate PLA/CSN "green" bionanocomposite through melt-extrusion for potential high-temperature engineering and food-packaging applications. Optimum loadings of ~1 wt. %, bionanocomposites show well-dispersed CSNs covering the entire matrix, corroborated through morphological analysis, leads to significant improvement in thermal, mechanical, barrier, and processing capabilities. Non-isothermal cold-crystallization and isothermal melt-crystallization studies were carried out using differential calorimetry and polarized optical microscopy. It reveals that CSN inclusions act as heterogeneous nucleating agents resulting in lower cold-crystallization temperatures, shorter crystallization half-time and enhanced growth rates. Thermal-degradation kinetic studies show that the apparent activation energies (E_a) of nanobiocomposites increased in comparison to pure PLA which inform that CSNs impede the thermal degradation process. Electrospun scaffolds of bionanocomposite showed BHK-21 cytocompatibility. We demonstrated improved cytocompatibility using alignment of MGCSNs due to effective fiber-drawing process. Concomitant use of curcumin and hyperthermia reduced the cancerous cell growth to ~63% towards use in cancer therapy.