National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Development of a thermosensitive self-assembled nanofibrous bioink for bone tissue engineering using an opensource 3D bioprinting approach
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Venue	: Seminar Hall, BM Department
Date and Time	: 24 Sep 2025 (4:00 PM)
Abstract	: Polyelectrolyte complex (PEC)-based thermosensitive bioinks are promising for bone tissue engineering due to their biocompatibility, tunable mechanics, and extracellular matrix (ECM)-like architecture. Formed through electrostatic interactions, they avoid cytotoxic crosslinkers but often lack structural fidelity and bioactivity for robust osteogenesis. This work addresses these challenges by developing self-assembled PECs in fibrous form to improve stability, mechanical strength, and biofunctionality. A chitosan&ndashpolygalacturonic acid hydrogel was first fabricated, exhibiting an elastic modulus of 16 kPa, ~3% swelling, and complete biodegradation within eight days. Scaling down the fibrous structure yielded self-assembled nanofibrous aggregates (SNAs), particularly chitosan&ndashgelatin SNAs (CG-SNAs), which enhanced ECM mimicry, reduced gelation time (165 ± 6 s), and improved 3D printability. Incorporation of nanohydroxyapatite (nHAP) further enhanced osteoconductivity, reducing swelling to 2.5%, retaining 48% weight after 10 days, and promoting osteogenesis through increased ALP activity, collagen synthesis, and mineralization.To broaden material scope, SNAs from diverse polymer combinations were evaluated, with gelatin&ndashcarrageenan showing the strongest osteogenic potential. Finally, osteoinductive nanoparticles&mdashincluding nHAP, laponite, magnesium whitlockite (Mg-WKT), and SiO_2&mdashwere integrated, with Mg-WKT demonstrating the highest osteogenic performance and reinforcing physicochemical properties. This synergistic strategy offers a scalable, cost-effective route for biomimetic bioinks with strong translational potential in bone regeneration and in vivo bioprinting.