ACID- AND SOLVENT- FREE MILD METHOD FOR THE PREPARATION OF NANOCRYSTALS OF CHITIN AND CELLULOSE

IITM Technology Available for Licensing

Problem Statement

- In the process of isolating nanocrystals, only a small fraction of the biomass is transformed into value-added material while the massive quantity of effluent generated requires further purification
- Hence, there is additional requirement of reducing the hazards to the environment, recovery of by products, cost, processing time (including dialysis), water, and energy

Technology Category/ Market

Category – Green Technology, Advanced materials
Applications –Waste treatment, biopolymer, manufacturing, Food processing
Industry –Nanotechnology ,Health care,, Environmental Engineering, Food industry
Market -**Chitin Market size** was valued at $42.29 Billion in 2020 and is projected to reach **$69.297 Billion in 2028**, growing at a **CAGR of 5.07%** from 2021 to 2028. **Cellulose market size** was USD 219.53 billion in 2018 and is projected to reach **USD 305.08 billion by 2026**, exhibiting a **CAGR of 4.2%** during the forecast period.

Intellectual Property

- **IITM IDF Ref. 1742**
- **IN406874 (PATENT GRANTED)**

Key Features / Value Proposition

Technical perspective

- Simultaneous synthesis of biopolymer nanocrystals viz. **chitin and cellulose nanocrystals and carbon nanodots** (a valuable by-product) from chitin and cellulose based raw materials using thermal treatment followed by **oxidant treatment and/or mechanical disintegration.**
- The crystallinity index of the samples was found to be 92 % for chitin NC (for the starting material it was 81%) and 90 % for cellulose NC (73% for cotton).
- Removal of excess acid as gypsum and recovery of sugars

User perspective

- **Highly efficient, cost effective, facile and scalable**

Technology

- **A process for producing biopolymer nanocrystals and carbon nanodots**, the process comprising the steps of:
  - **Thermally treating biopolymer raw material to form fragments**
  - **Treating the fragments to separate biopolymer nanocrystals and carbon nanodots.**
- The biopolymer raw material for **chitin is prawn** shell and for **cellulose is cotton and pulp sheets**.
- Upon controlled treatment, the polymeric chains in the amorphous regions are fragmented leading to the formation of **chitin/cellulose nanocrystals**
- After the thermal treatment the fragments are oxidized with 1% sodium hypochlorite or 5% hydrogen peroxide to remove the carbonized organic matter, forming **chitin nanocrystals cellulose and carbon nanorods exhibiting green fluroscence**
- Further, microscopic and spectroscopic analysis confirm the formation of **chitin and cellulose**. nanocrystals

Image

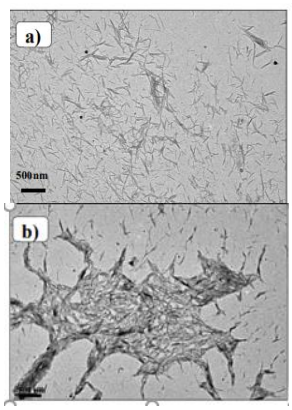

FIG. 1 illustrates TEM Images of (a) chitin nanocrystals and (b) cellulose nanocrystals

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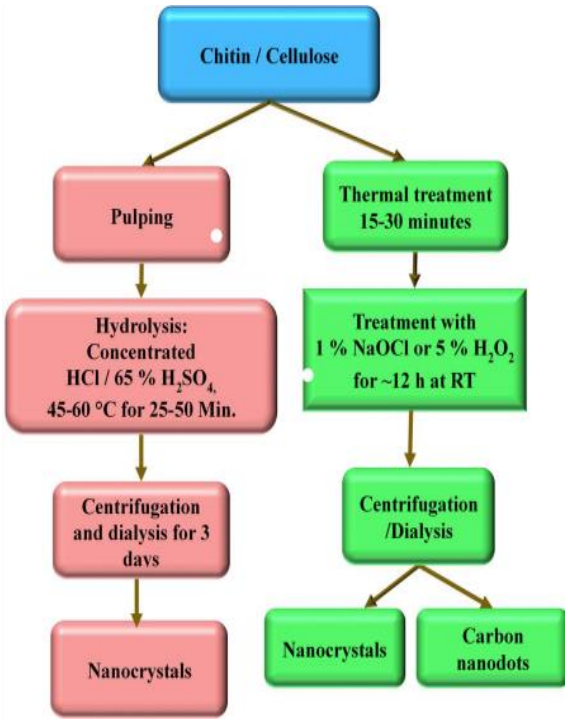

FIG. 2 illustrates the comparison flow chart for separation of nanocrystals from cotton and chitin by chemical method and current method.

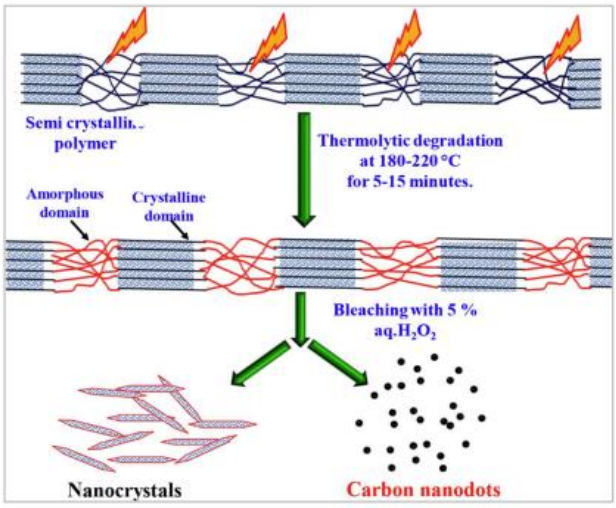

FIG. 3 is a schematic representation for preparation of chitin and cellulose nanocrystals by thermolytic method according to the present invention

FIG. 4 illustrates dispersions of cellulose NC (I), dispersions of cellulose NC taken with crossed polarizers (II) and chitin nanocrystals (III).

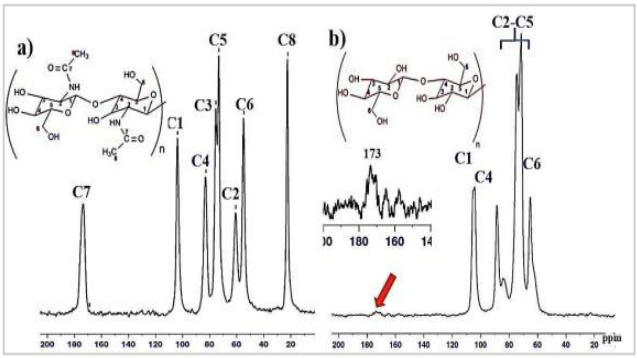

FIG. 5 illustrates the solid-state NMR spectrum of (a) chitin nanocrystals and (b) cellulose nanocrystals (and insert picture represents carbonyl peak from carboxylic acid groups).

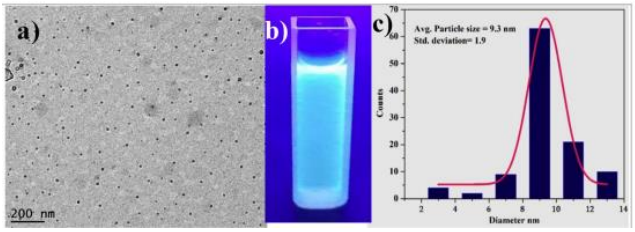

FIG. 6 illustrates carbon nanodots (CND-CH) isolated as by-product from the preparation of chitin nanocrystal: (a) TEM image, (b) photograph of fluorescence - and (c) histogram for particle size

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TRL (Technology Readiness Level)

TRL- 4 Technology Validated in Lab

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