Chitin Membranes and 2D Material Integration: A NMR Study Approach

Anjana Aravind, Prof. Dr. Eike Brunner

[1]TU Dresden (Germany)

The study's primary focus lies in the conversion of raw chitin into functional chitin membranes, explored through Nuclear Magnetic Resonance (NMR) techniques. Chitin is a versatile biopolymer sourced from crustaceans and has the potential for e.g., advanced energy storage applications. In future investigations, the integration of two-dimensional (2D) materials, particularly graphene oxide (GO), into these membranes is planned followed by NMR characterization.

The first phase of this research involves the conversion of raw chitin into chitin membranes using tailored fabrication techniques. Chitin is extremely stable due to the presence of acetyl, amino, and hydroxyl groups in the polymer chain and the presence of intermolecular and intramolecular hydrogen bonds make the chitin structure tightly bonded**.** Therefore, chitin does not dissolve in most regular solvents such as water, organic solvents, and even mildly acidic or basic solution. Due to this processing of Chitin is also challenging. Here we use ionic liquid for dissolving .

The resulting chitin membranes use NMR, to interpret their structural composition, dynamics, and interaction profiles. The research outlines plans for the incorporation of graphene oxide into the chitin membranes to strengthen their potential. The exceptional electrical conductivity and surface area of graphene oxide are expected to enhance charge transfer and storage efficiency. Subsequently, solid-state NMR and in-situ NMR techniques will be employed to comprehensively probe the chitin-graphene oxide hybrid membranes. The use of solid-state NMR will help us to understand the molecular arrangement and interactions within the hybrid material.

In summary, this research embarks on a dual-stage journey: first, from raw chitin to functional membranes, extensively studied using NMR techniques; and second, integrating graphene oxide for enhanced energy storage capabilities, followed by comprehensive NMR characterization. By intertwining bioresource utilization, advanced materials, and cutting-edge NMR techniques, this study contributes to the advancement of efficient composite.

References

[1] Hou J, Aydemir BE, Dumanli AG. Understanding the structural diversity of chitins as a versatile biomaterial. Philos Trans A Math Phys Eng Sci. 2021 Sep 20;379(2206):20200331. doi: 10.1098/rsta.2020.0331. Epub 2021 Aug 2. PMID: 34334022; PMCID: PMC8326827

[2] Ikram R, Mohamed Jan B, Abdul Qadir M, Sidek A, Stylianakis MM, Kenanakis G. Recent Advances in Chitin and Chitosan/Graphene-Based Bio-Nanocomposites for Energetic Applications. Polymers (Basel). 2021 Sep 25;13(19):3266. doi: 10.3390/polym13193266. PMID: 34641082; PMCID: PMC8512808.

[3] Zhao Y, Park RD, Muzzarelli RA. Chitin deacetylases: properties and applications. Mar Drugs. 2010 Jan 14;8(1):24-46. doi: 10.3390/md8010024. PMID: 20161969; PMCID: PMC2817921.