BUTTERFLIES Project

Bio-Polymers & Additive Manufacturing

Newsletter I

Non-reactive bio-adhesive for binder jetting of chitin powder

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Non-reactive bio-adhesive for binder jetting of chitin powder

Binder jet printing (BJP) of robust and crystalline materials such as chitin poses several challenges arising from the powder characteristics, binder formulations, and the process parameters. Among these, the binder exerts a strong influence, as it governs not only the printing behavior but also the structural cohesion and mechanical performance of the final printed component. To achieve high-quality parts, the binder must be chemically compatible with chitin to promote effective interparticle bonding and meet the targeted performance requirements.

To follow single-component additive manufacturing, chitin nanocrystals (ChNCs) and chitosan have been selected as the primary binder components. Their common origin ensures chemical compatibility with the chitin powder, while their complementary roles enhance the binder's performance: ChNCs contribute to reinforcement, whereas chitosan offers excellent adhesion and film-forming ability. Together, they can enable the formulation of a single-component, bio-based binder system that enhances bonding strength, mechanical integrity, and overall durability of binder jet printed chitin structures.

To align with sustainability goals, the binder formulations will be prepared using water or bio-based solvents and will involve minimal chemical modification of the raw materials. At this stage, the central aspect of the work is to elucidate the interactions between binder components and their interfacial compatibility with chitin powder. This understanding will provide a scientific basis for the rational design of environmentally responsible, high-performance binders.

Within this framework, Task 2.1 aims to investigate the interactions between anisotropic chitin nanocrystals (ChNCs), isotropic polysaccharides such as chitosan, and chitin powder (Figure 1). Understanding these relationships will help optimize the mechanical performance of the binder formulations. The studies will be carried out under various solvent environments, compositions, and binding conditions. At this stage, binder properties are expected to rely primarily on physical interactions, self-assembly, and macromolecular entanglement. The insights gained from this task

will form the foundation for designing more robust and efficient binder systems in subsequent stages of the project.

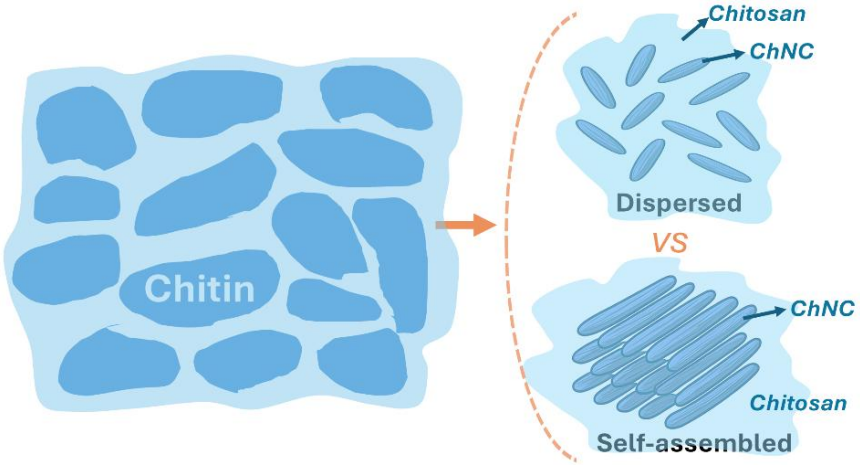

Figure 1: Chitin powder bonded by chitin nanocrystal-based adhesives. Properties will be studied to demonstrate the impact of dispersed and self-assembled chitin nanocrystals in the adhesive formulations.