

Continuous Roll-to-Roll Fabrication of High Performance Transparent CNC Coatings for Plastic

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- Materials and Manufacturing

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- Cellulose
- Coatings
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- Nanocrystals

Coatings for plastic materials have a variety of purposes including use as a gas barrier, inking, and resistance to scratching. However, existing technologies, such as hard-coats, corona/plasma treatments, or other available technologies, suffer from high cost and low performance in these areas. Cellulose nanocrystals (CNCs) are an alternative renewable raw material derived from abundant resources such as wood, plants, algae, tunicate, bacteria, etc. CNCs have excellent properties such as nontoxicity, biodegradability, high specific strength, high thermal conductivity, and optical transparency. Based on these remarkable properties, CNCs are applicable as a reinforcement component in nanocomposites, transparent media in organic electronics, anti-counterfeiting in security applications, and barriers in packaging applications. CNCs can form a coating, film, aerogel, or foam depending on the desired final application. There is an unmet need for an inexpensive, fast process, with large-scale continuous fabrication of CNCs onto flexible substrates to ensure uniform CNC coating with controlled anisotropy.

Researchers at Purdue University have developed a large-scale manufacturing process for CNC coatings on flexible substrates, using a novel method of continuous roll-to-roll (R2R) fabrication of CNC coatings with controlled anisotropy and a novel method to prepare the CNC coated flexible substrate. For a given gravure roll, gravure speed, substrate speed, and ink viscosity were determined to be the most important parameters that control the liquid transfer from the ink bath to the substrate. This determines the coating thickness. Using pristine raw materials allows control of the crystalline domains of the materials that exhibited enhanced properties. Potential customers include polymer sheet/film manufacturers or flexible electronics/sensor producers, who want high transparency coatings on plastic for gas barrier, inking, or scratch resistance. Specifically, a CO₂ and O₂ barrier performance better than ethylene vinyl alcohol polymer has been attained via this process.

Advantages:

- Uses low-cost R2R production with improved performance

- High transparency coatings
- Exhibits enhanced barrier properties

Potential Applications:

- Barrier coatings
- Polymer sheet/film manufacturers
- Flexible electronics/sensor producers

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Intellectual Property:

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