

Distribution study of biopolymers coatings on films and cellulosic materials for packaging application

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Horizon 2020
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AGENDA

1. Introduction
2. Near infrared spectroscopy- Hyperspectral imaging system
3. ECOFUNCO: Distribution study of biopolymers coatings on films and cellulosic materials for packaging application.
4. Case study: Distribution study of biopolymers coatings on films materials
5. Case study: Distribution study of biopolymers coatings on cellulosic materials.



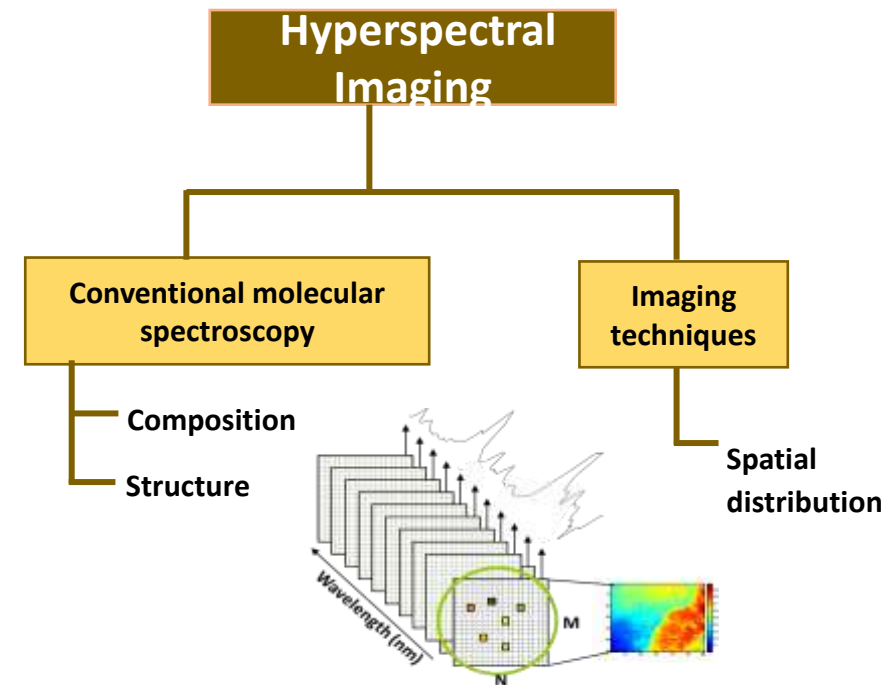
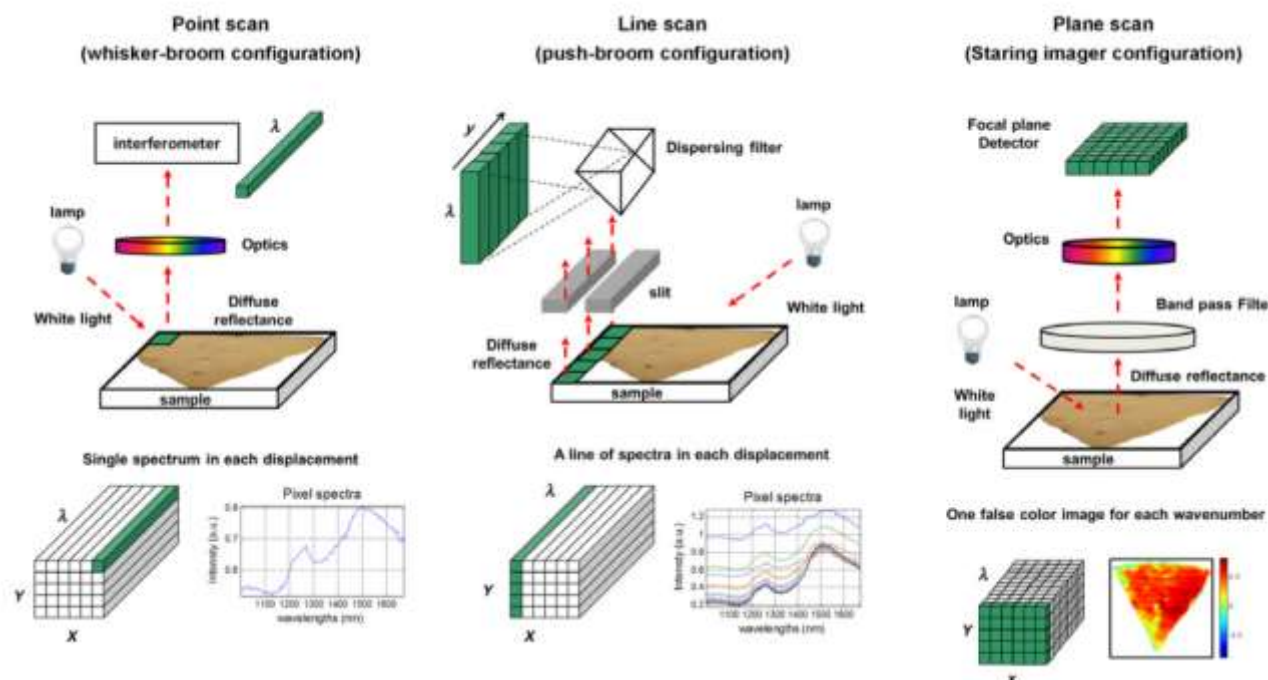
1. Introduction

IRIS TECHNOLOGY SOLUTIONS S.L

- ❑ More than a decade on the market.
- ❑ Facilities and offices in Barcelona.
- ❑ 70 highly qualified multidisciplinary employees.
- ❑ Among the top 10 European SMEs with R&D projects awarded under H2020.
- ❑ Manufacturer of monitoring and analysis systems for industry (NIR, **HSI**, RAMAN).
- ❑ Creator of a patented product line under the Visum brand.
- ❑ Developer of customised cloud storage-based software platforms with integrated AI engines.
- ❑ Provider of advanced technical services.



2. Near infrared spectroscopy- Hyperspectral imaging system



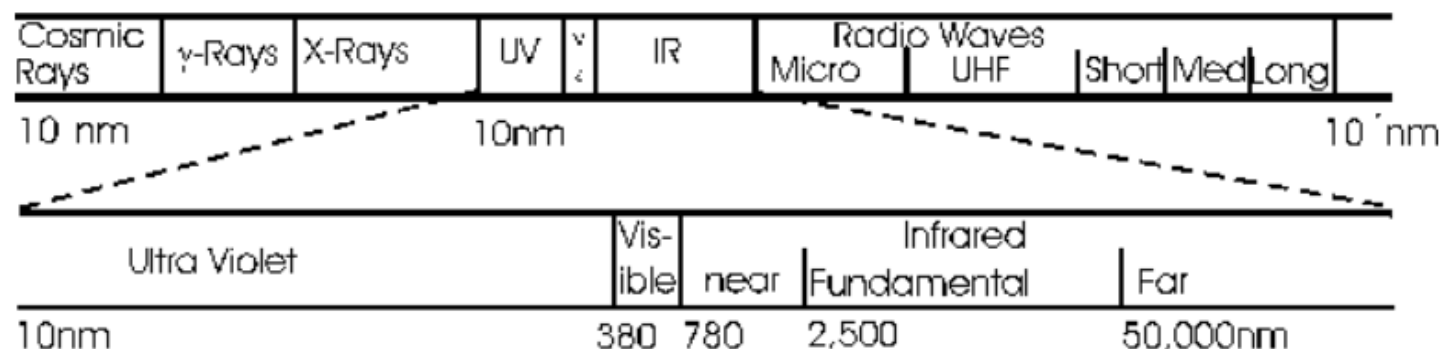
- ✓ Rapid analysis in real-time.
- ✓ Multiple parameters can be analysed simultaneously.
- ✓ Non-destructive, non-invasive.
- ✓ Chemical-free.
- ✓ Wide range of materials.

[1] J. M. Amigo, I. Martí, and A. Gowen, "Hyperspectral Imaging and Chemometrics. A Perfect Combination for the Analysis of Food Structure, Composition and Quality," *Data Handl. Sci. Technol.*, vol. 28, no. July, pp. 343–370, 2013.

2. Near infrared spectroscopy- Hyperspectral imaging system

- ✓ NIR was discovered by William Herschel in 1800.
- ✓ Increase in temperature of a thermometer in the region outside the dispersed visible spectrum near red.
- ✓ Herschel later verified that rays follow the properties of waves, such as reflection, refraction, interference and diffraction.
- ✓ NIR range: 780 – 2500 nm
- ✓ Mid.IR range: 2,5 – 25 μm
- ✓ Far IR range: 5 μm – 1mm

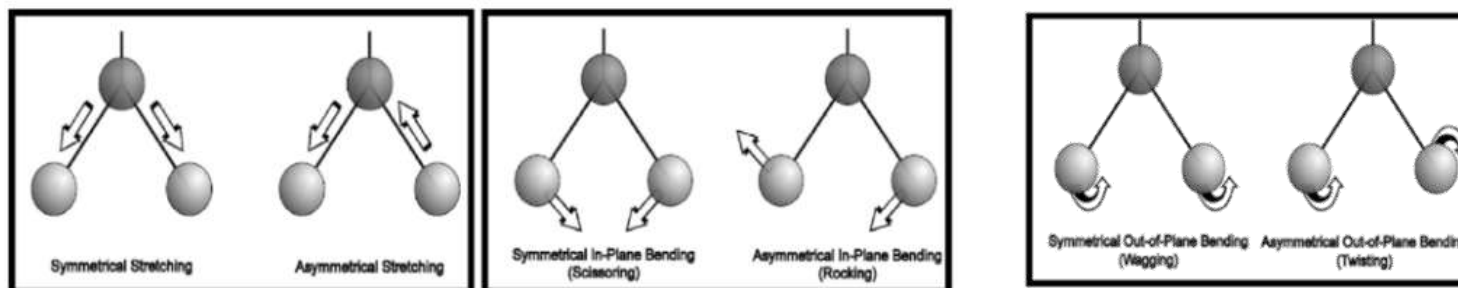
NIR: electromagnetic spectrum



[2] A.M.C. Davie, An introduction to near infrared (NIR) spectroscopy, IMPublicationsOpen, <https://www.impopen.com/introduction-near-infrared-nir-spectroscopy>

2. Near infrared spectroscopy- Hyperspectral imaging system

- ✓ The absorption at different wavelengths contains information about the chemical composition of the material.



[3] Mohamed, E.S., et al., Egypt. J. Remote Sensing Space Sci. (2017)

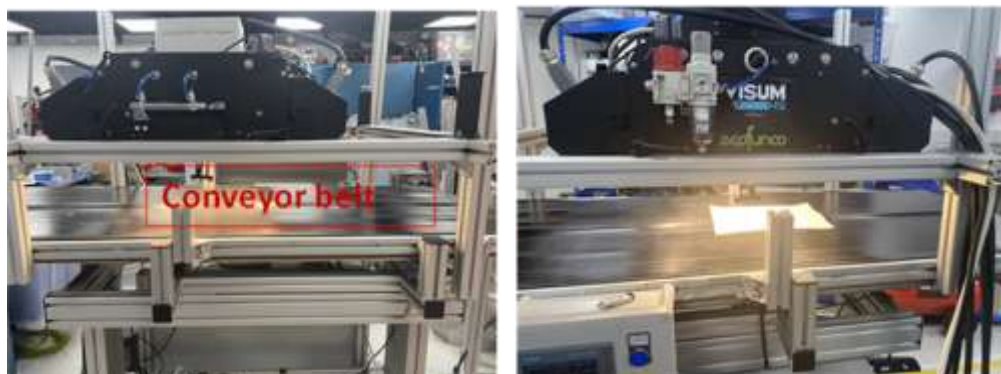
- ✓ Absorption is due to the vibrations of the chemical bonds in the molecules, with primary absorption in the overtones and combination in the NIR range.
- ✓ Most of the bands appearing in the NIR range are attributed to functional groups (e.g. OH, CH, NH) containing a hydrogen atom.

3. ECOFUNCO: Distribution study of biopolymers coatings on films and cellulosic materials for packaging application

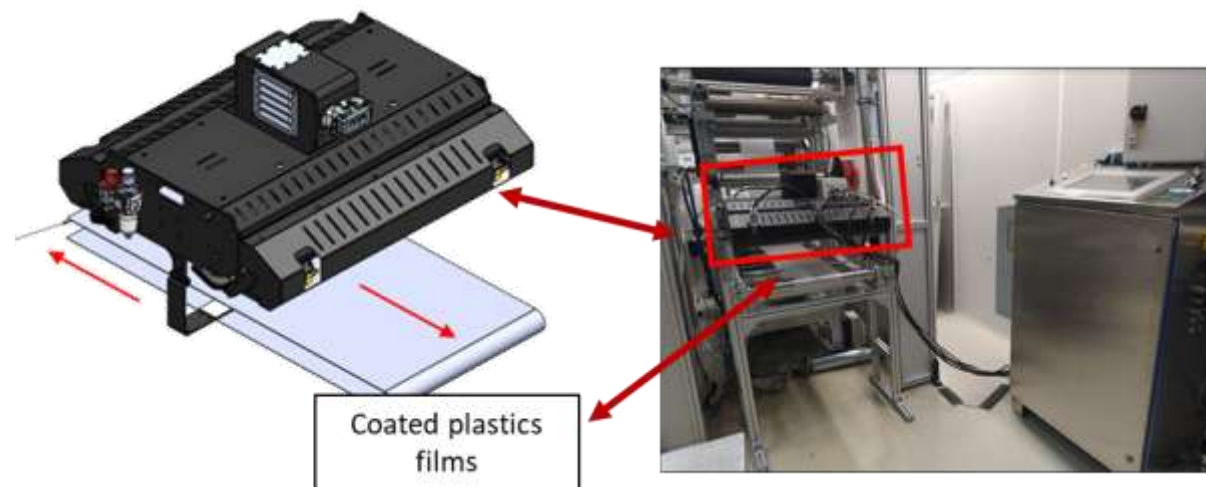
- ☐ The distribution of coating is an important parameter to warrant properties (e.g. to ensure a sufficient barrier to protect food).
- ☐ The distribution of coating is an important to ensure that the materials quality will be consistent without using more resources than needed.
- ☐ **AIM:** Study the distribution of biopolymers coatings on films and cellulosic materials for packaging application.

3. ECOFUNCO: Distribution study of biopolymers coatings on films and cellulosic materials for packaging application

Distribution study of biopolymers coatings on cellulosic materials



Distribution study of biopolymers coatings on films materials

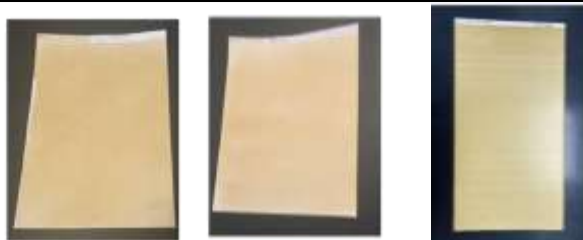


3. ECOFUNCO: Distribution study of biopolymers coatings on films and cellulosic materials for packaging application

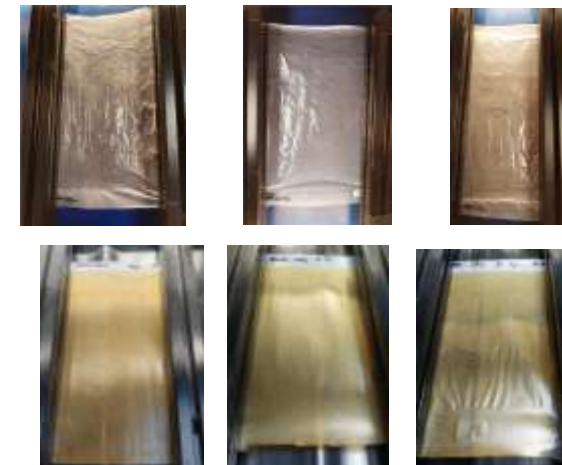
- ❑ Some biopolymers coatings evaluated in the projects are cutin, chitin and Protein
- ❑ Biopolymer coatings on films materials provided by Fraunhofer facility (films materials coated with biopolymer coating of protein with 32.5% solid content).
- ❑ Cellulosic materials virgin paper coated with cutin and chitin coatings provided by LUCENSE facility.

Distribution study of biopolymers coatings on cellulosic materials

Set 3: Chitin (6 samples) - RECYCLED PAPER
Recycled samples with chitin 125 g/m ²
Recycled samples with chitin 185 g/m ²
Recycled samples with chitin 200 g/m ²
Set 1: Cutin coatings (3 samples) - VIRGIN PAPER
Coating: CMC 1.5 %, Solid residue (S.R), 10.5%, 15 ml
CMC 1.5 %, S.R, 10.5%, 10 ml
CMC 1.5 %, S.R, 5.3%, 20 ml

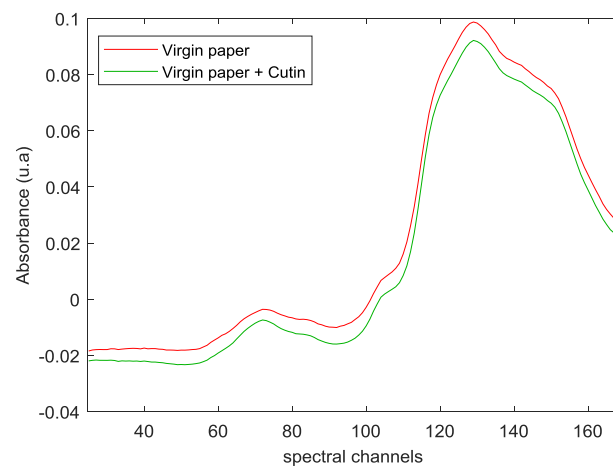


Distribution study of biopolymers coatings on films materials



4. Case study: Distribution study of biopolymers coatings on cellulosic materials for packaging application

Virgin paper coated with/without Cutin



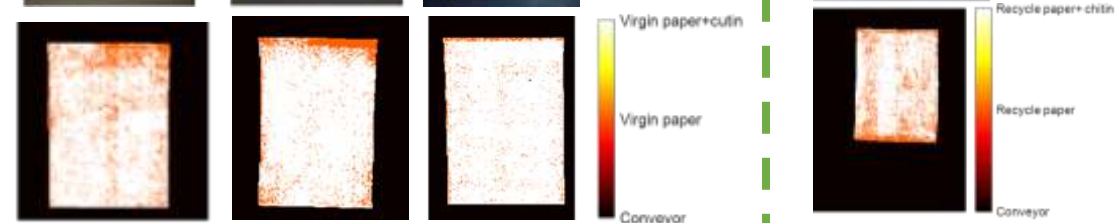
No differences could be visually observed from the spectroscopy signals. Three main absorption and used to build the chemometric models.

Examples of calibrated virgin paper samples with and without Cutin/chitin

RGB pictures



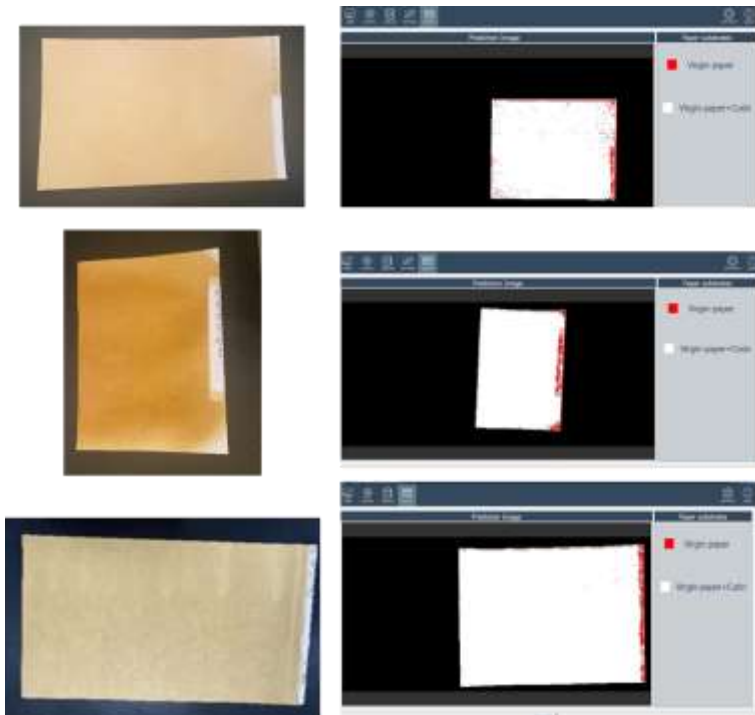
Prediction images



- Coated virgin papers are identified as white, while the uncoated virgin surfaces are orange. From the results, one can see the presence and absence of the cutin on the virgin paper substrates. In addition, the areas where the samples have not been distributed well can also be visualised.

4. Case study: Distribution study of biopolymers coatings on cellulosic materials for packaging application

Inline validation of coated paper with Cutin (IRIS)



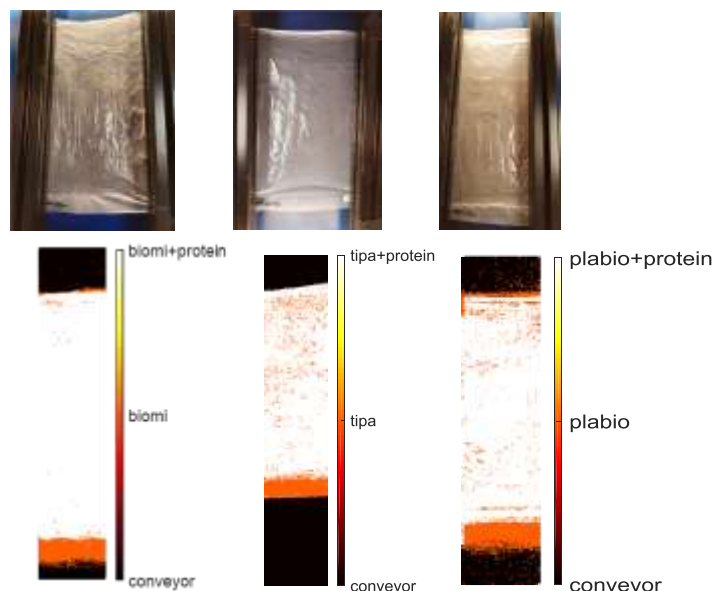
Inline validation of coated paper with Chitin (IRIS)



- Cutin validation: Some virgin paper was not homogeneous, though improvement is observed by increasing the quantity of volume of applied cutin solutions.
- Chitin validation: Recycled papers with 125 g/m², 185 g/m² and 250 g/m² chitin were used to validate the model. Recycled paper with and without chitin could be identified properly. The results show that it is possible to investigate the homogeneity of the coating on the cellulose substrates.

5. Case study: Distribution study of biopolymers coatings on cellulosic materials for packaging application

Offline calibration with the HSI system



- Spectroscopy signa: New features between 120 to 160 channels for the Plabio and TIPA302 materials, that could be associated with the interaction between the bioplastics and the coatings materials. Increase tendency for the between these channels.
- HSI results: HSI result allows differentiation between surfaces with and without protein coating on the three different bioplastics.

Validation with the HSI system



- Inline validation: it is possible to investigate the homogeneity of the coatings on the bioplastic. Bioplastics with a greater thickness of the coatings could be classified as more homogeneous
- Overall result seem promising and useful technique to study the distribution of the coatings on the film materials.

Thank you. Questions ??
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ECOFUNCO PARTNERS

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LUCENSE

