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## Intelligent food packaging: RFID bio-based sensing label to monitor food shelf life

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# Intelligent food packaging

## RFID bio-based sensing label to monitor food shelf life

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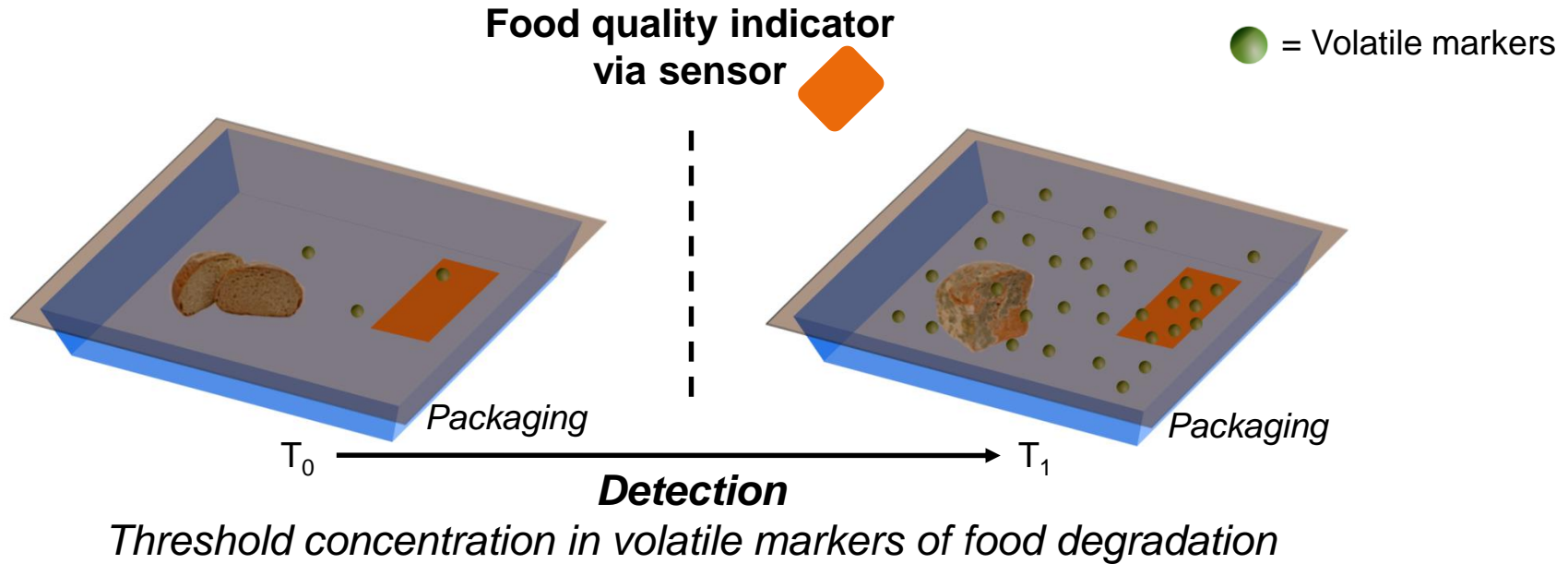
**Fabien BIBI – PhD Student (2012 – 2015)**

**Director: Nathalie GONTARD**

**Co-directors: Carole GUILLAUME, Brice SORLI**

# Objective

## Development of the sensing bio-material



## Coupling of RFID (Radio Frequency Identification) tag with the sensor

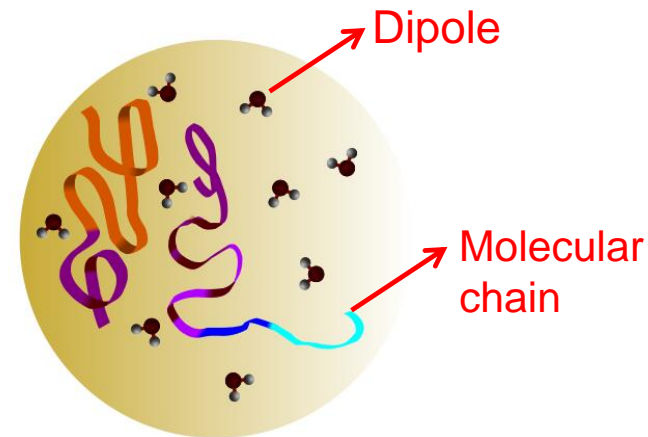
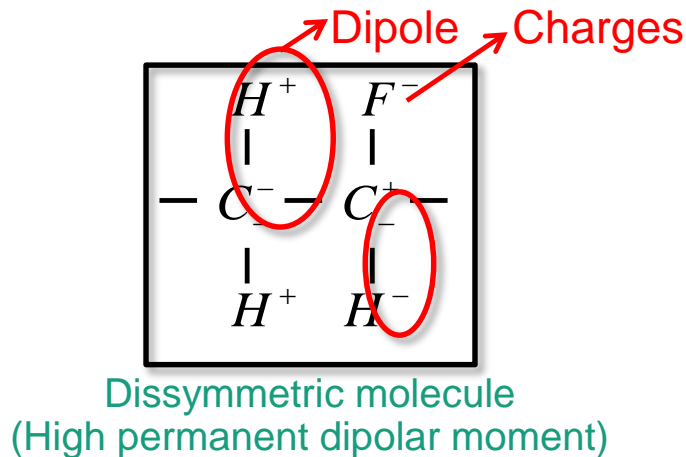
**RFID:** Wireless system for transferring data from a tag attached to an object



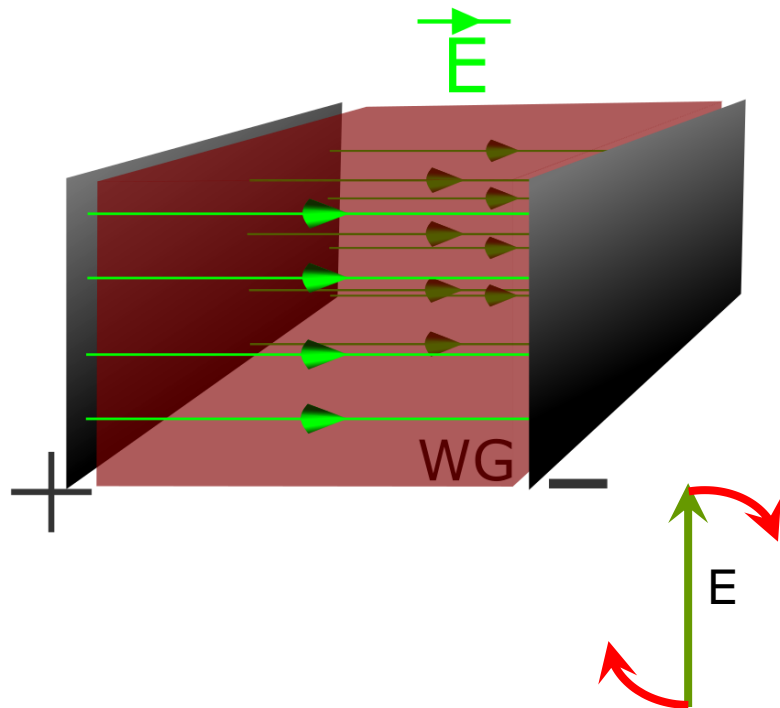
# Sensor: Dielectric material

## Vegetal protein: Wheat Gluten

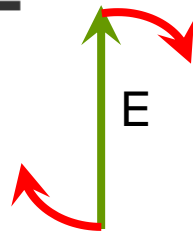
- “bio” material and can be coated onto a substrate.
- displays sensitivity to gases and vapors (considered as food quality markers).
- exhibits electrical properties and dielectric properties (Dipoles, charges, charged molecular chains).



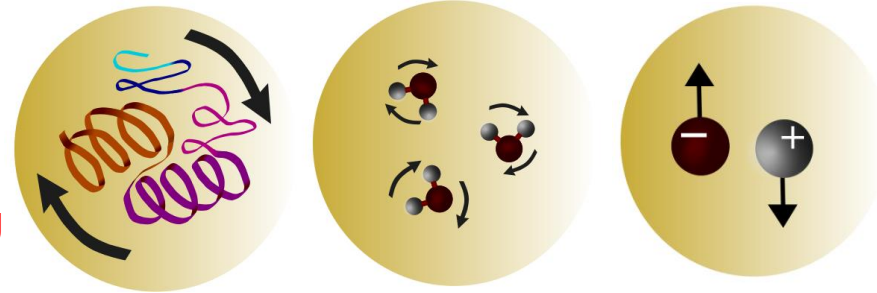
# Effects of electric field on Wheat Gluten



- Alternating electric field impacts:
  - Movement of molecular chain,
  - Rotation of dipoles,
  - Movement of charge.



Alternating field

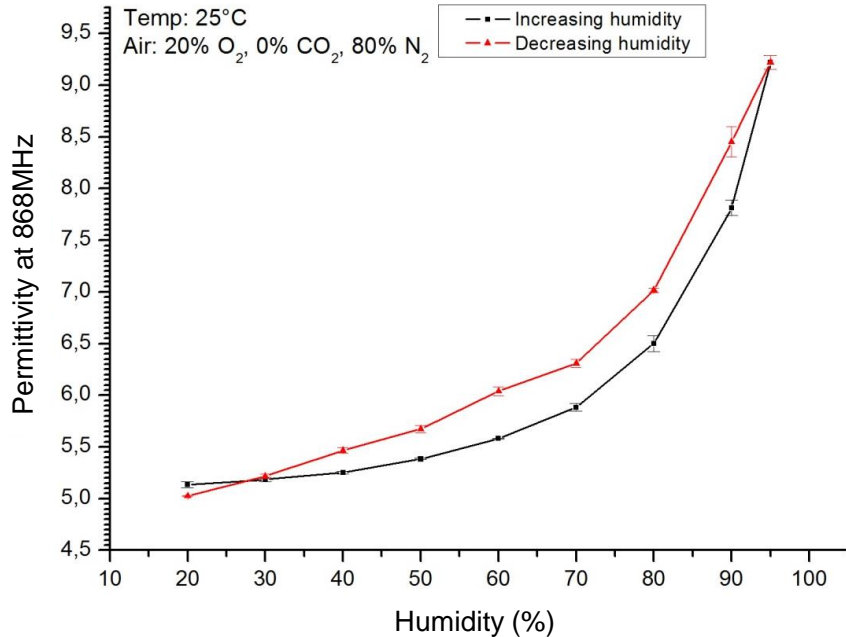


⇒ Energy induced in the wheat gluten material.

⇒ **Energy stored** (dipoles, polarization): rep. by **permittivity ( $\epsilon'$ )**.  
**Energy loss** (conduction, friction): rep. by **dielectric loss ( $\epsilon''$ )**.

# Effects of relative humidity (RH) on wheat gluten

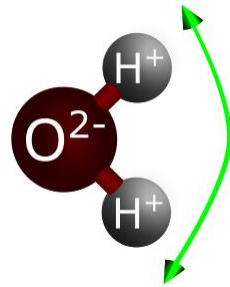
## Permittivity



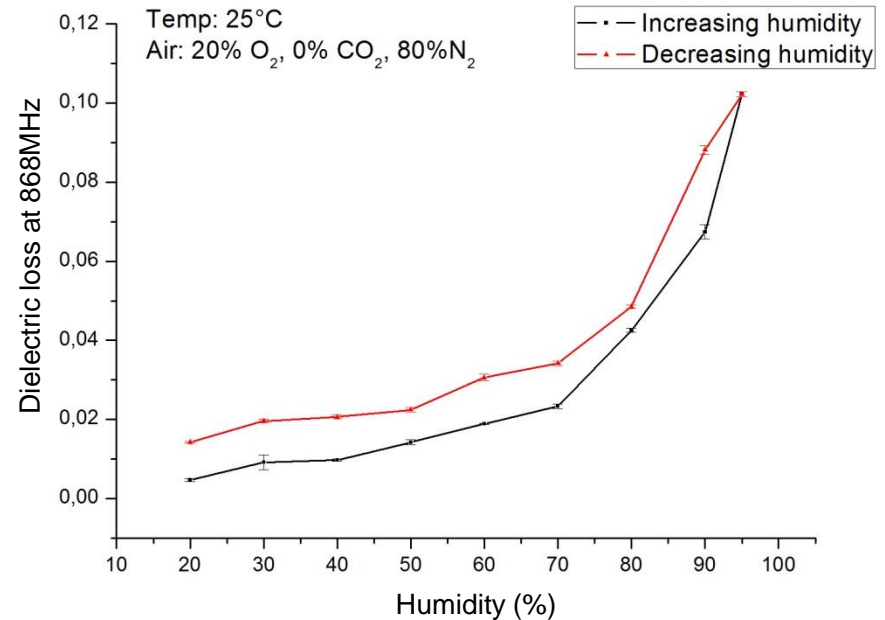
### Increase of permittivity with increase in RH.

- More polarizations because of water (dipole).
- Increase mobility of molecular chain and dipoles.

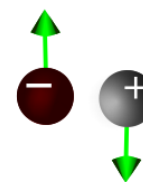
(Electromagnetic properties: Dielectric properties of food)



## Dielectric loss



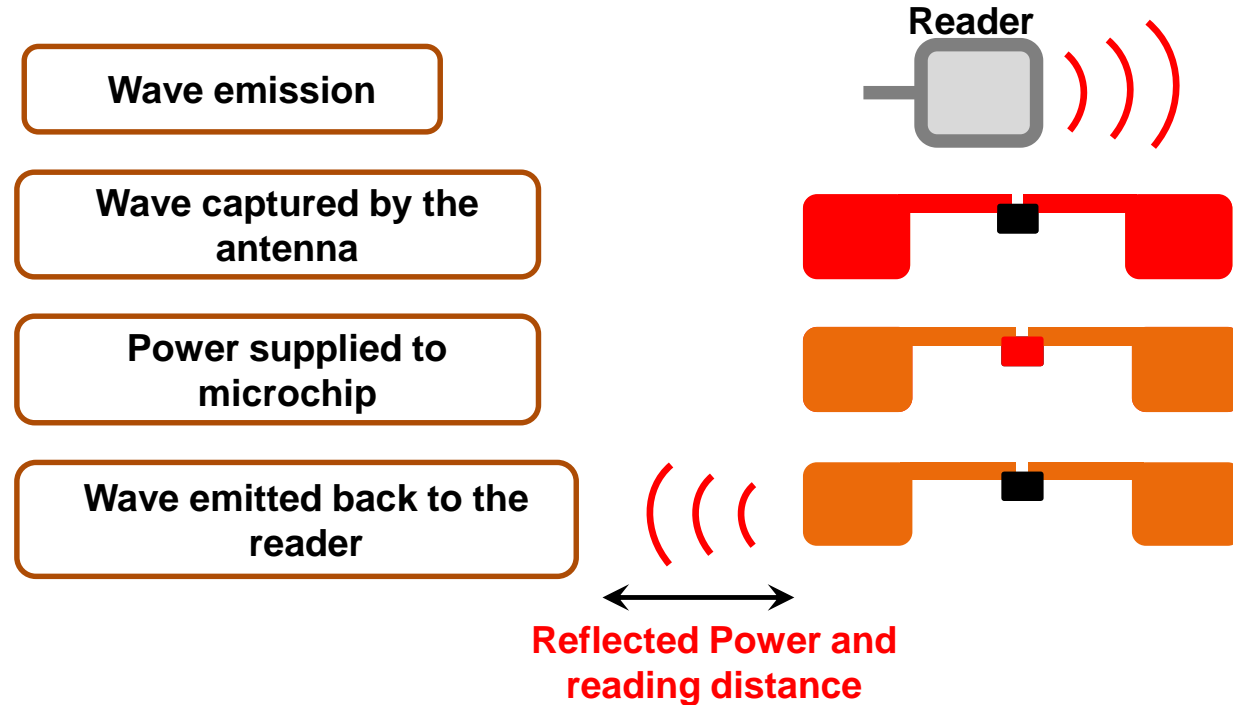
### Increase in dielectric loss with increase in RH.



- Increase mobility of charges in the network. (J.Ahmed, 2007).
- Lossy medium. (S.Ryyniinen, 1995).

# RFID (Radio Frequency Identification)

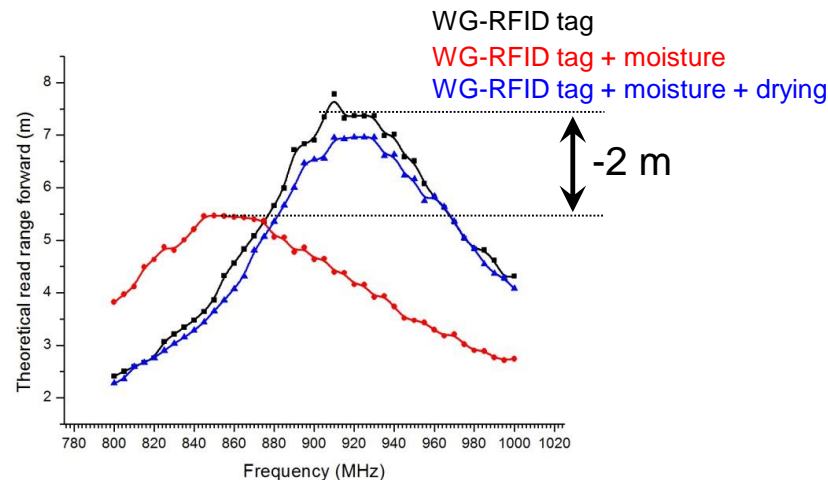
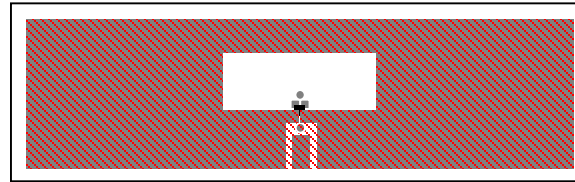
## How does RFID work?



# RFID + wheat gluten coated : Effects of relative humidity

- Effects of humidity on wheat gluten (permittivity and dielectric loss) => Modification of electrical property of RFID antenna.
  - Modification in reflected power.
  - Modification in reading distance.

## RFID tag with wheat gluten layer deposited – Impact on reading distance





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Thank you for your attention!!