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# ELECTRICAL CHARACTERIZATION OF DIFFERENT CARBON BASED POLYMER COMPOSITES

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# ELECTRICAL CHARACTERIZATION OF DIFFERENT CARBON BASED POLYMER COMPOSITES

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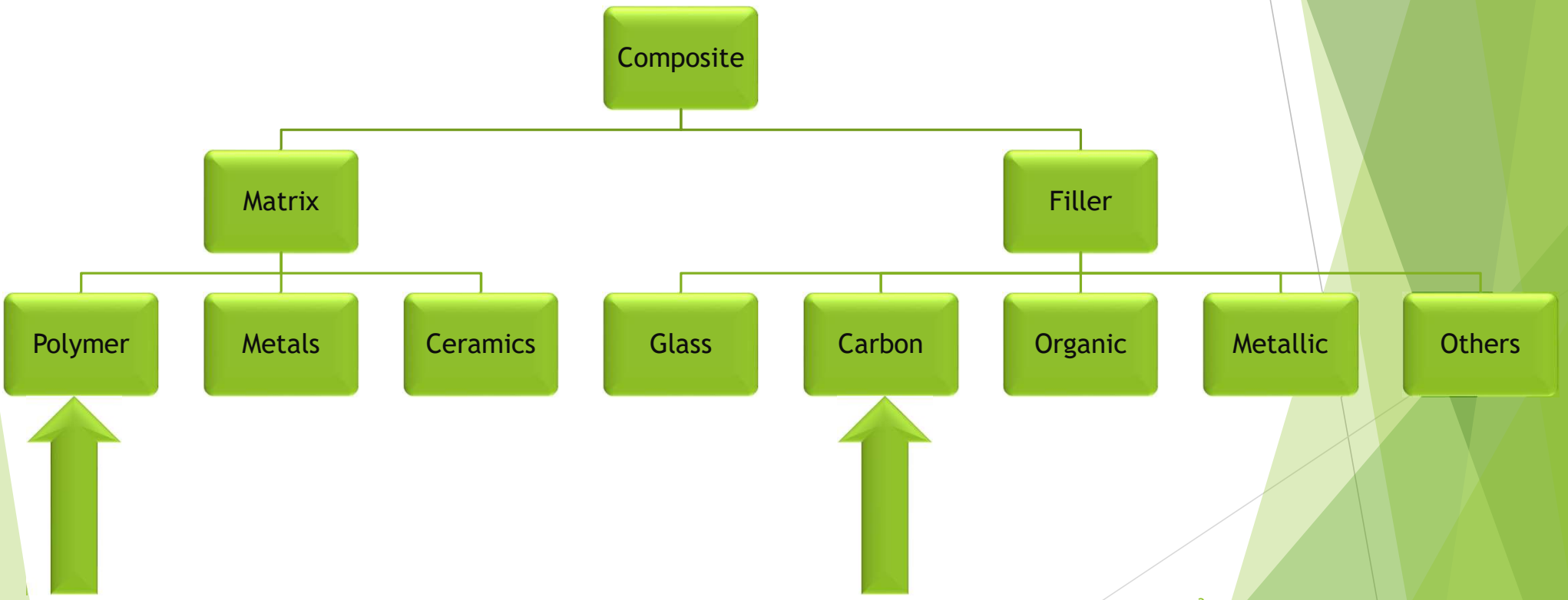
**Biorefinery I**: Chemicals and Materials from Thermo-Chemical Biomass Conversion and Related Processes

# Outline

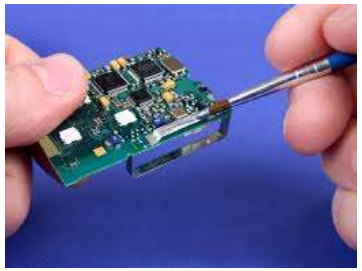
- Motivation and Application
- Biochar as Carbon Filler
- Composite preparation
- Microwave characterization
- Results
- Comment and comparasion with CNTs
- Conclusions

# Motivation and Application



# Motivation and Application

- Electrical & electronics
- Energy & power
- Automotive
- Aerospace



# Biochar as Carbon filler by iocfar

- Chemical decomposition of organic materials in the absence of oxygen

- Products:

- Gases (non-condensable vapors)

- Liquids (condensable vapors: bio-oil

Solids (bio-char and ash)

# Biochar as Carbon Filler

- Advantage:

Low price

Recicled material

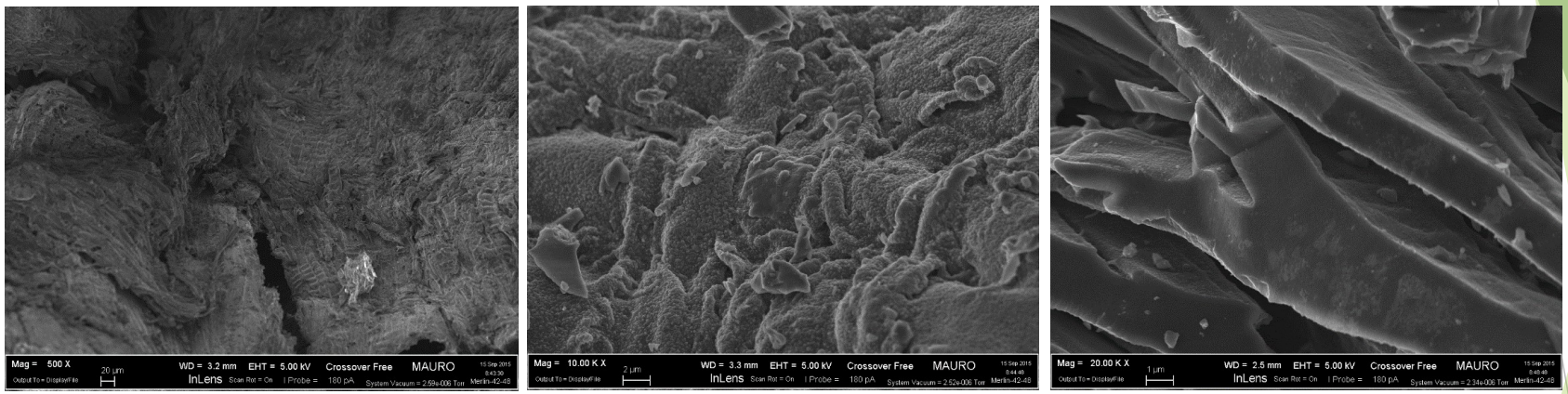
New opportunities

# Composite preparation

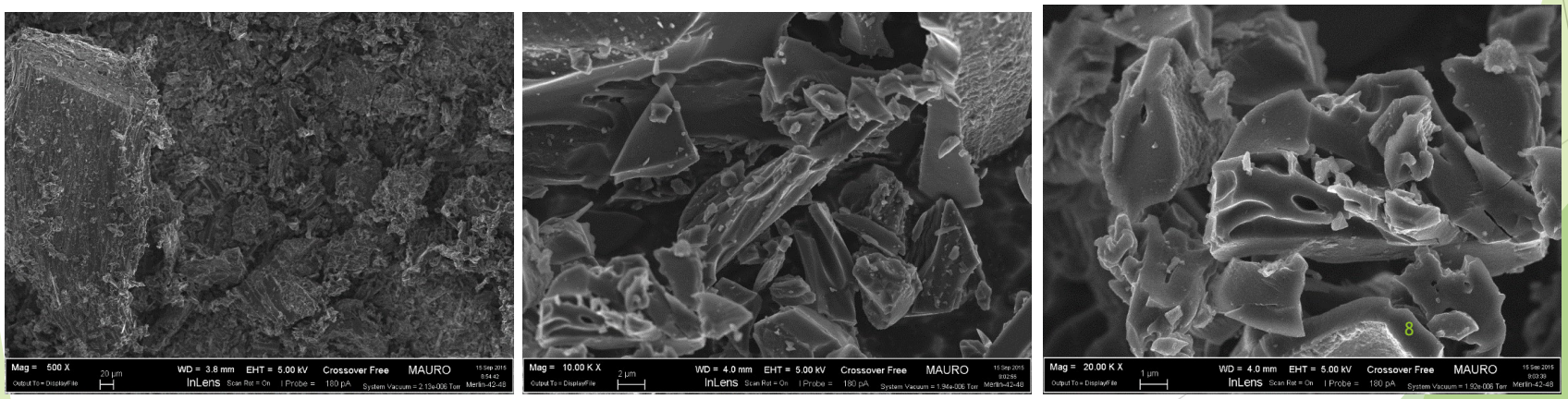
- Pulverize by blade mixer

# Composite preparation

- Fesem characterization (Zeiss supra 40)




As it is




Powder

# Composite preparation

A crucial point to obtain good dispersion

**Mixing procedure**

**Ultra turrax mixer**

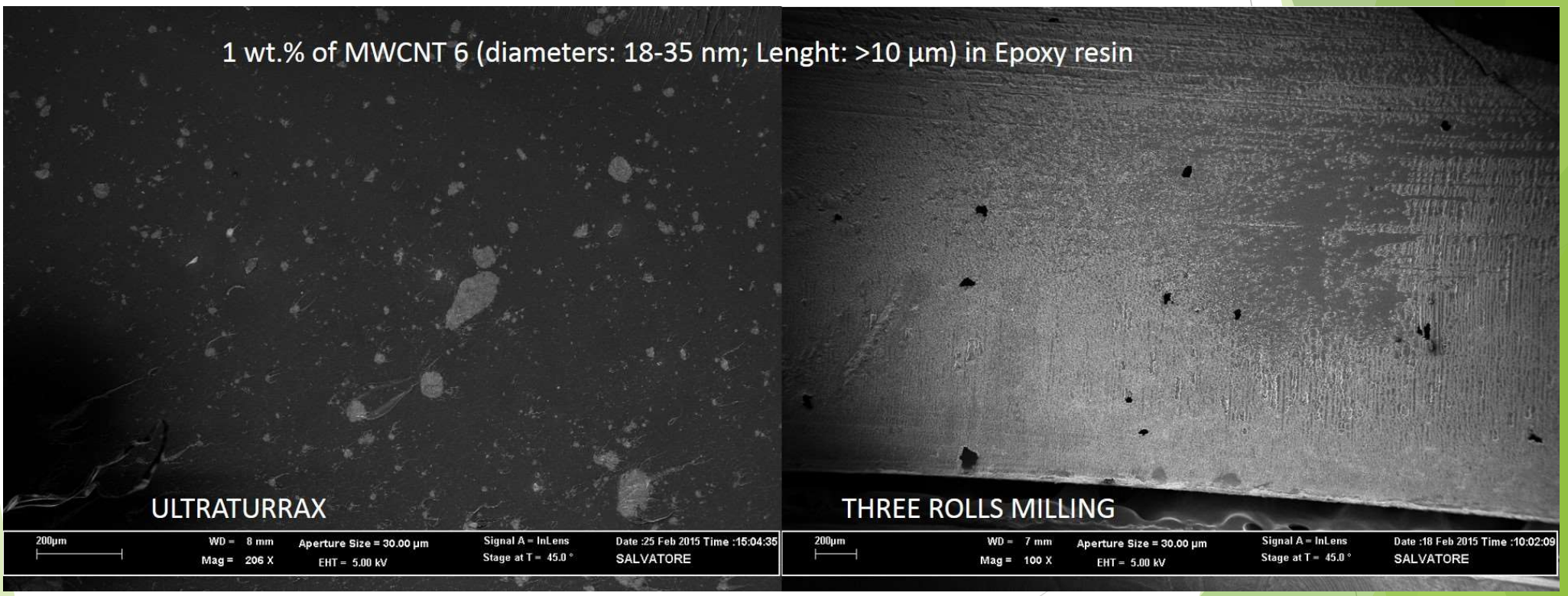
Low quantity material is enough

**Three roll mills mixer** (Recently acquired)

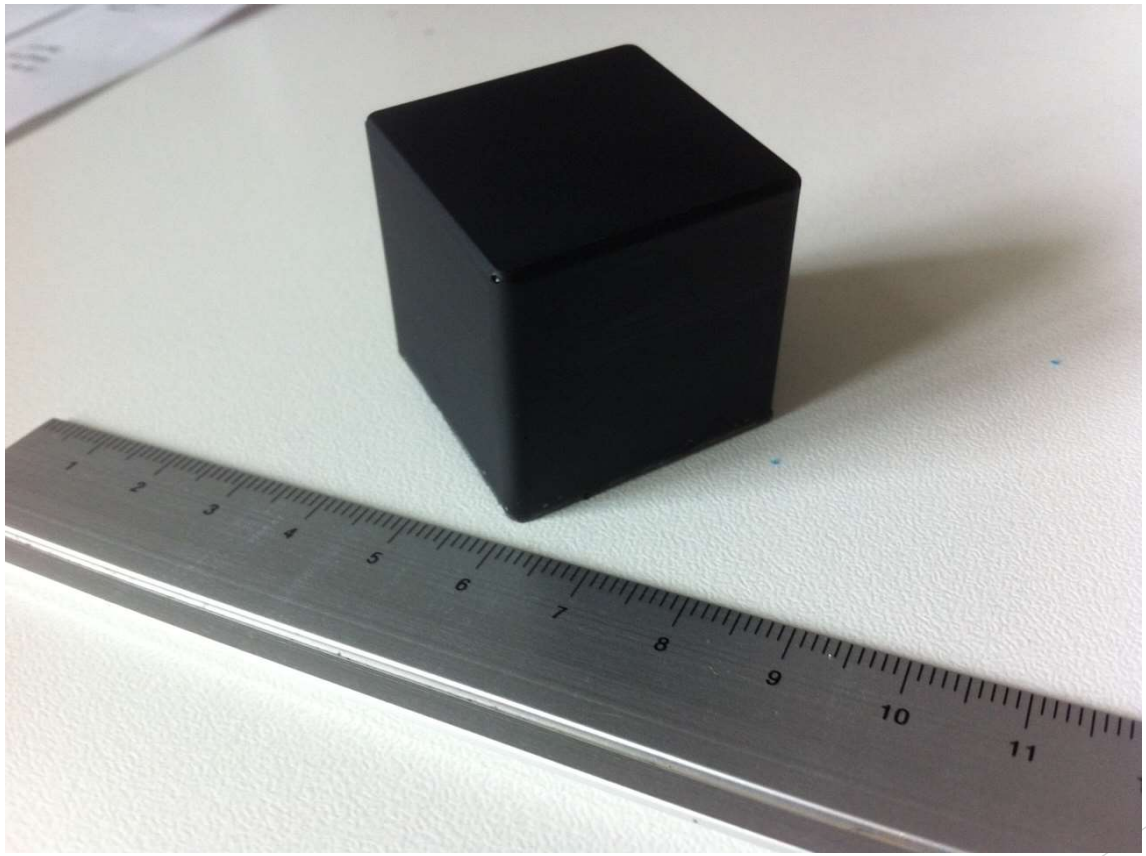
Needs Not less 50 ml of material

# Composite preparation

*Comparison between different dispersion technique in case of Carbon Nanotubes (CNTs)*



# Composite preparation

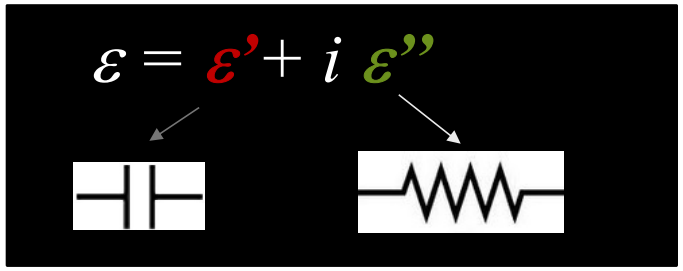


# Microwave characterization

## Permettivity measurements

The most common way to describe a system response to an electro- magnetic wave is through its dielectric constant (also called permittivity)

**Permittivity** is a complex quantity. Its **real part** describes the **ability to store energy** while its **imaginary part** describes the **ability to dissipate energy**




$$\varepsilon = \varepsilon(f)$$

As electrical conductivity is related to energy dissipation a close correlation exists

$$\varepsilon'' = \frac{\sigma}{2\,\pi\,f\,\varepsilon_o}$$

# Microwave characterizations

**A Network Analyzer (E8361A) + A commercial dielectric probe (Agilent 85070D)**

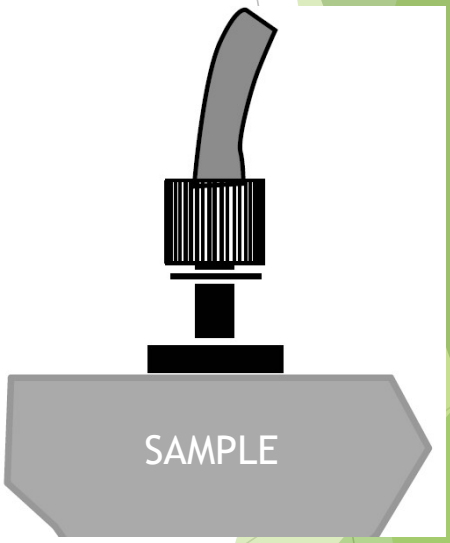
**Advantages:**

☺ Frequency band 200 MHz – 20 GHz
☺ Fast response
☺ Samples of small dimensions

**Drawback:**

☹ Roughness and flatness of the surface are critical
☹ Thick samples

Ø = 2.2 cm

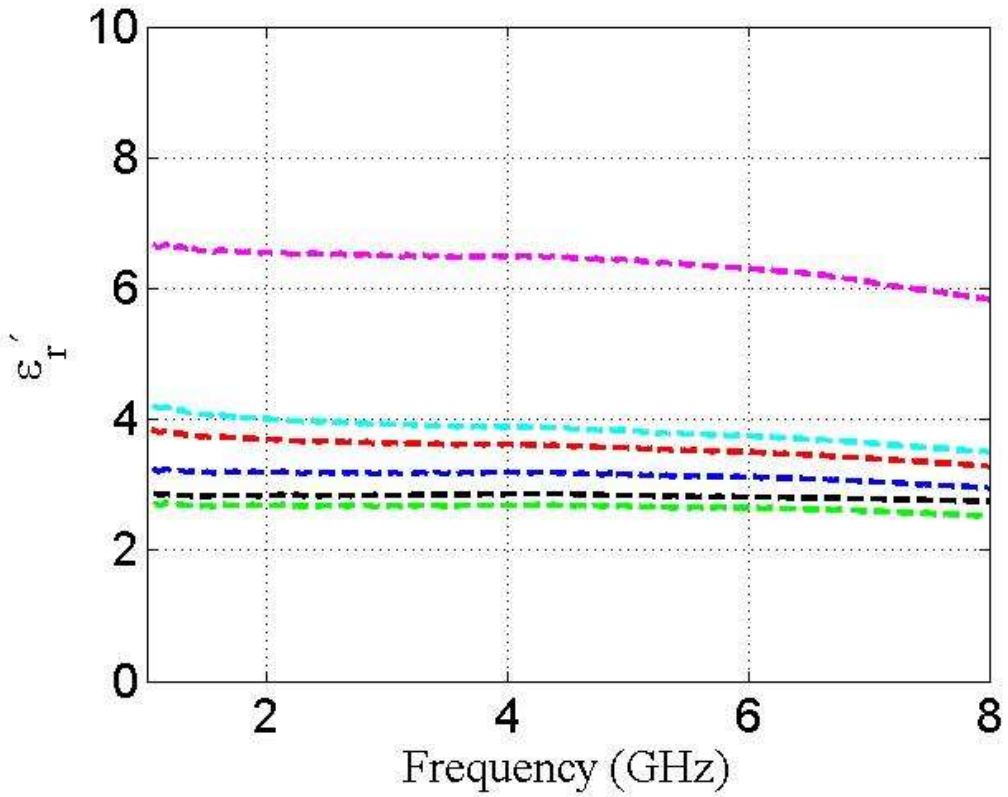



Sample thickness > 1.5 cm

# Results

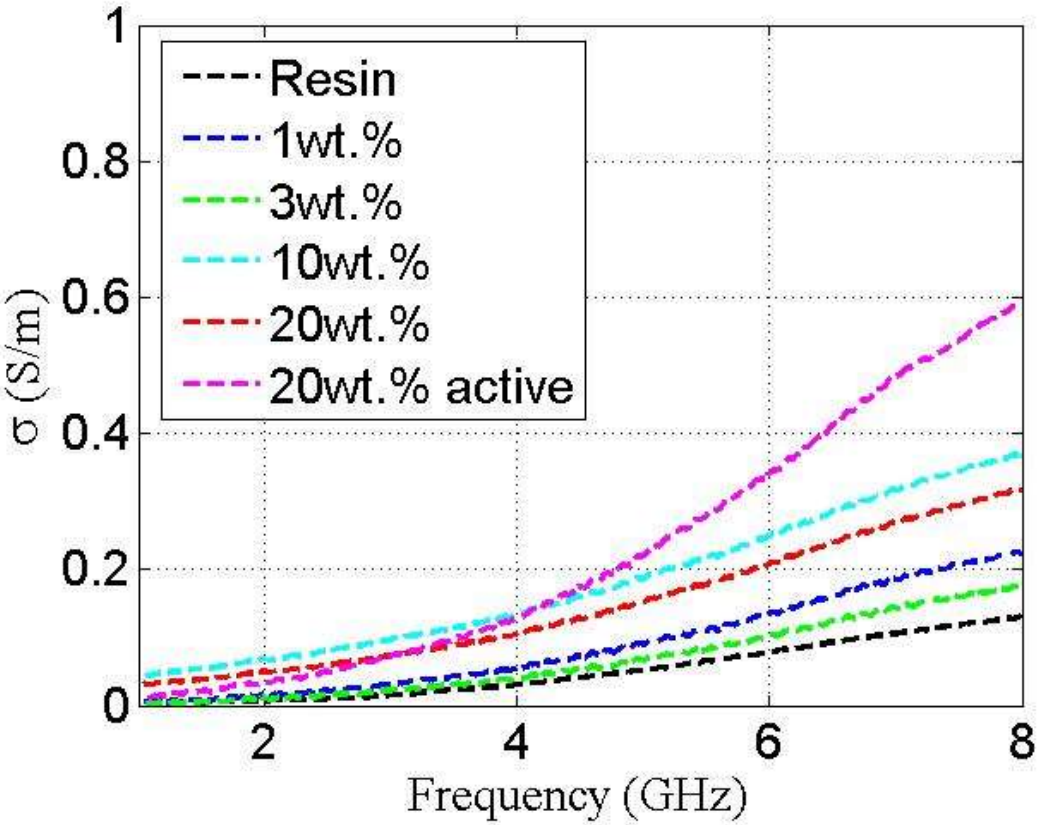
- Standard Biochar
- Activated Biochar (high surface area)
- Comparison with CNTs

# Results (real part)



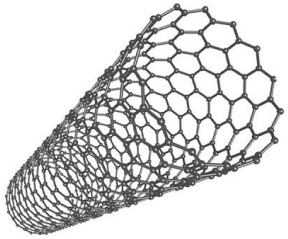

Resin
1wt.%
3wt.%
10wt.%
20wt.%
20wt.% active

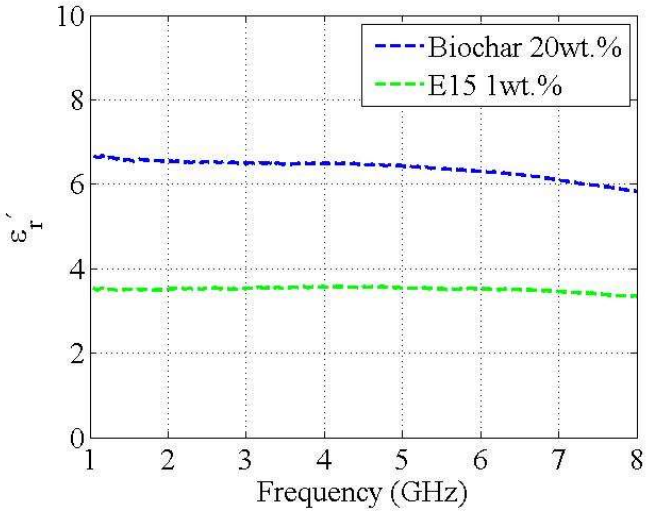
# Results (Conductivity, immaginary part)



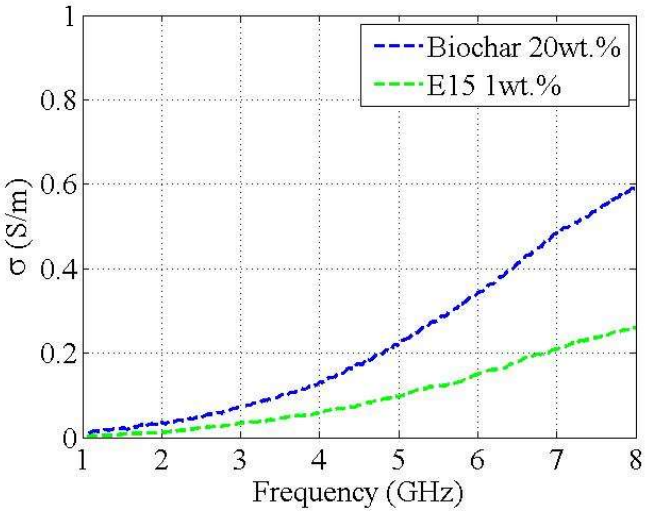

$$\varepsilon'' = \frac{\sigma}{2\,\pi\,f\,\varepsilon_o}$$

# Results (comparison with CNTs)






**Real part**




**Conductivity**

# Conclusions

- Low quantities of Biochar fillers have **not effect** on permittivity as CNTs
- To obtan effect on permittivity we need to be **more than 10 wt.%**
- **Activated Biochar** (high surface area) have more effect respect to no activated Biochar
- In order to have compared values with CNTs we need to arrive **around 20 wt.%**
- Further investigation are need in particular to test **mechanical properties.**

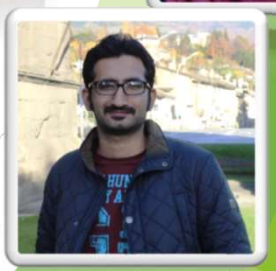
# Thank you for your attention









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