Biochar based silicon composites for sensors applications

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Presentation outline

• Biochar in Composites
• Biochar Electrical conductivity
• Biochar in Silicon matrix
• Biochar as possible carbon filler in composite
• Conclusions
Biochar in Composite

Goal: use biochar to increase:
- Mechanical properties
- Electrical properties
- (Thermal properties)

In composites based on:
- Polymers
- Cement
- ...

Why biochar?
- High carbon content
- Porous
- Stable (low reactivity)
- Low cost/recycling material
- Quite easy to disperse
Biochar in Composite

Promotion of: \( \rightarrow \) mechanical adhesion of polymer chains
\( \rightarrow \) electrical transport of electrons

**Polymer:** Epoxy resin

**Biomasses:**
- a) Wheat straw WSP
- b) Oil Seed Rape OSR
- c) Rice Husk RH
- d) Mixed softwoods SWP
- e) Miscanthus Straw MSP

: biochar particles
: polymer chain

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*Article*

Influence of Commercial Biochar Fillers on Britteness/Ductility of Epoxy Resin Composites

Mattia Bartoli \(^{1,4,5}\), Mauro Gnocchi \(^{1,4}\), Carlo Rosso \(^{5}\), Massimo Rovere \(^{1}\), Pravin Jagdale \(^{4}\) and Alberto Tagliabue \(^{1,4}\)

*MDPI*
Biochar Electrical Conductivity

Evaluation of biochar electrical conductivity before composite preparation

Biochar Electrical Conductivity

Evaluation of biochar electrical conductivity in composite

Ohm law for conductivity ($\sigma$): $\sigma = \left(\frac{l}{RS}\right)$

Polymer: Epoxy resin
Biomasses: Coffee

Presented at: Frontiers in polymer science
Biochar in Silicon Matrix

Evaluation of biochar electrical conductivity in composite

What we have to take in account to increase the electrical conductivity in composites:

- **Particle size** (low dimensions $\rightarrow$ best dispersions $\rightarrow$ increase the electrical conductivity)

- **Biochar graphitization grade** (it increases with temperature treatments ($>400^\circ\text{C} \rightarrow$ Raman)

- **Biochar porosity** in function of its ability to be grinded in small particles
  (CO2 activation could help, preliminary tests)

- **Low ash content**
Biochar in Silicon Matrix

Goal: sensor application

Suggested polymer: soft polymer → Silicon

Behaviour like solid in a liquid, to study well...
Biochar in Silicon Matrix
Biochar in Silicon Matrix

Realization of pressure sensor device based on biochar

Polymer: Silicon
Biochar: Olive 1500
Conclusions

• Biochar represents a great opportunity in composite field

• Indisputable advantages: → low cost
  → green/ recycling material

  ... And it works!
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Alessandro Sanginario, Researcher

Prof. Alberto Tagliaferro, Head

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