

“Investigation of multi-walled carbon nanotubes aqueous dispersions via electrical impedance spectroscopy”

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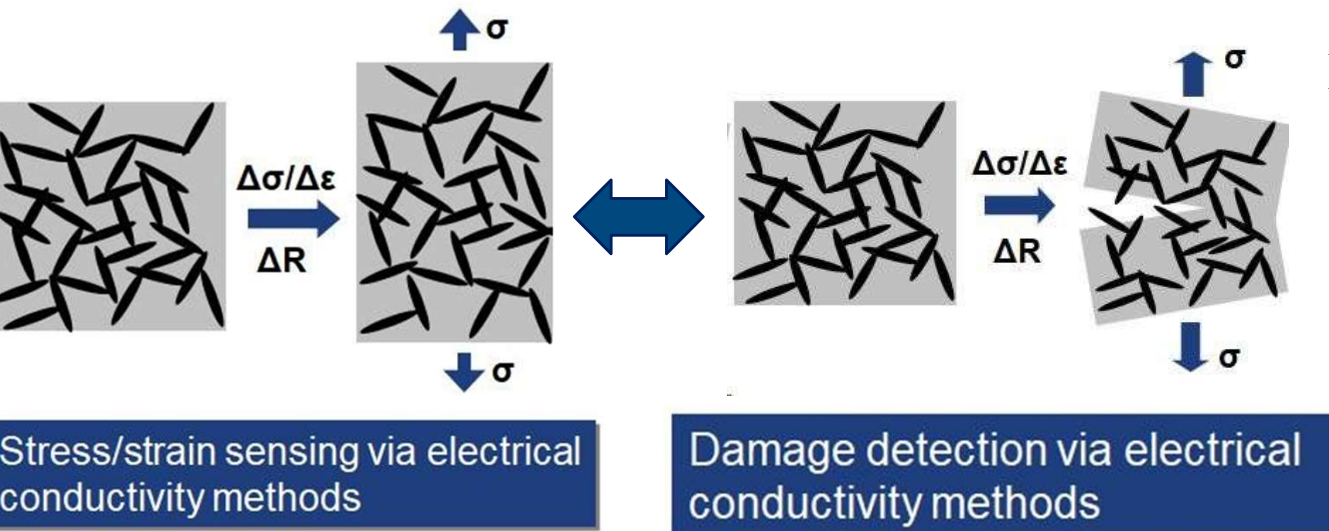
Poster ID

3182

In situ detection via electrical conductivity method

An electrically conductive matrix :

- Allows health monitoring in nanocomposites
- Improves detectability of matrix dominated failure mechanisms



**Innovative application:
Lime-based restoration materials**



Experimental procedure – aqueous dispersion of carbon nanotubes (CNTs)

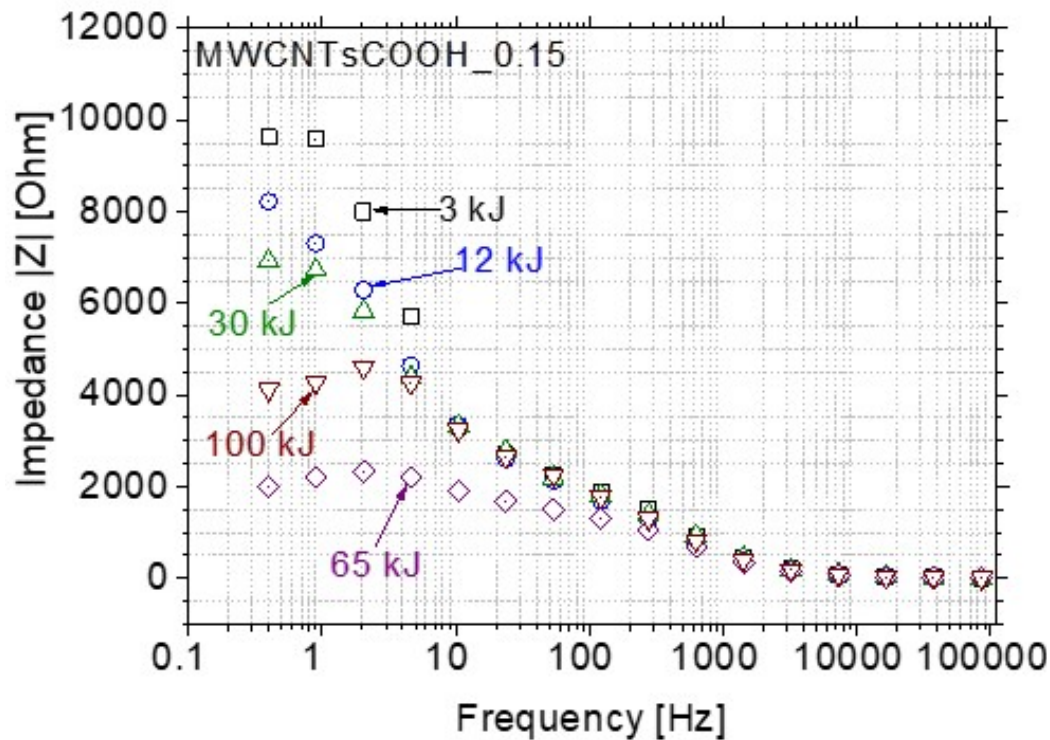


- While ultrasonic energy was applied, **electrical impedance spectroscopy (EIS)** was also conducted
- A small sensor is exploited for on-site (field) direct dielectric EIS measurements with the application of alternating current (AC).

EIS experimental test setup consisting of

- computer software,
- sensor,
- dielectric thermal analysis system,
- ultrasonic sonicator

Results : Dispersion of CNTs



Bode plots of an investigated CNTs dispersions 0.15 wt% at different ultrasonic energy levels

- As the **ultrasonic energy increases**, the **dispersion becomes more uniform** with lower size of agglomerates.
- Lower impedance values mean that more conductive paths between nanostructures are formed and allow for the electrical current to pass.
- Nevertheless, at high energy level the ultrasonication :
 - i. destroys the surface groups of the CNTs-particles
 - ii. decreases their lateral size
 - iii. tend to re-agglomerate.

Conclusions

- The aqueous dispersions of CNTs with superplasticizer showed significantly higher impedance at low energy levels but the comparative respective values are lower after 65 kJ ultrasonic energy.
- The dielectric measurements were exploited to to facilitate with the dispersion control of the nanostructures.

Acknowledgments

This research is funded by the Research e- Infrastructure “Interregional Digital Transformation for Culture and Tourism in Aegean Archipelagos” {Code Number MIS 5047046} which is implemented within the framework of the “Regional Excellence” Action of the Operational Program “Competitiveness, Entrepreneurship and Innovation”. The action is co-funded by the European Regional Development Fund (ERDF) and the Greek State [Partnership Agreement 2014- 2020]

 <p>European Union European Structural and Investment Funds</p>	 <p>HELLENIC REPUBLIC MINISTRY OF DEVELOPMENT AND INVESTMENTS SPECIAL SECRETARIAT FOR ERDF & CF PROGRAMMES <small>MANAGING AUTHORITY OF "COMPETITIVENESS" PROGRAMME</small></p>	<p>ΕΡΑΝΕΚ 2014-2020 OPERATIONAL PROGRAMME COMPETITIVENESS ENTREPRENEURSHIP INNOVATION</p>	 <p>ΕΣΠΑ 2014-2020 ανάπτυξη - εργασία - αλληλεγγύη Partnership Agreement 2014 - 2020</p>
<p>Co-financed by Greece and the European Union</p>			