Twinned Modelling – Characterisation (MODA-CHADA) Solutions for Electronic and Energy Materials: from H2020 MMAMA and NanoBat to M-ERA.NET ULTCC6G_Epac and I4BAGS Projects

Malgorzata Celuch, Marzena Olszewska-Placha, Łukasz Nowicki, Janusz Rudnicki

QWED Sp. z o.o., ul. Krzywickiego 12 lok.1, 02-078 Warsaw, www.qwed.eu
[1] mceluch@qwed.eu [2] molszewska@qwed.eu [3] lnowicki@qwed.eu [4] jrudnicki@qwed.eu

Key Words: *Materials Modelling, Materials Characterisation, Multiphysics Problems, Electronic Materials, 5G / mmWave Materials, Energy Materials, Batteries.*

Abstract

The poster will present a twinned MODA-CHADA approach (Fig. 1) as proposed and pursued by our team in the research on modelling-based electromagnetic characterisation of materials:

- Computational modelling is performed with the use of QuickWave™ software [1], applied in the design of laboratory instruments for material measurements in GHz frequency range, and where Digital Twins of such instuments are now implemented. Each characterisation process is twinned to the corresonding modelling workflow, from which outputs are used to map the measured GHz signals into parametres of the material under test (Fig. 1).
- The new instruments are based on SPDR and SiPDR microwave techniques [2] validated in many industrial projects including the emerging 5G/mmWave technologies [3]. The most prominent recent implementations are SPDR (Fig. 2) and SiPDR scanners, which allow 2D imaging of, rerspectively, high-resistivity and conductive materials' surfaces. Example aplications have been presented in e.g. [4] and [5].

Our twinned modelling-characterisation technology has been recognised as a European Innovation Radar [6] and reached the finals of the EU IR 2021 Prize [7]. More information including modelling tools, examples, data sets, and presentations are provided at [8]

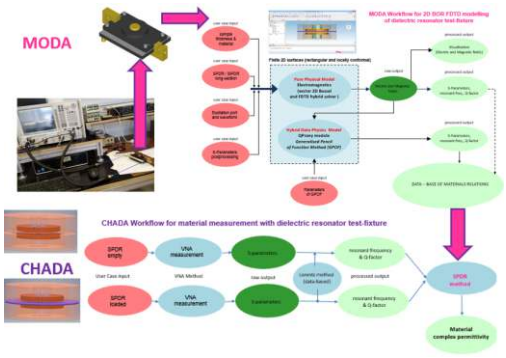

Fig. 1. Concept of twinned MODA-CHADA for GHz-resonator techniques as proposed by QWED in EU projects.

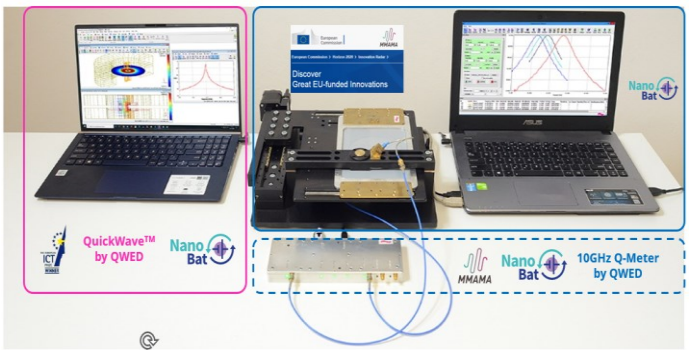

Fig. 2: Implementation in the form of surface scanner for GHz-imaging of electronic and battery materials - Finalist of the European Innovation Radar Prize 2021.

Acknowledgement: The work received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements MMAMA No. 761036 and NanoBat No 861962, and is currrently co-funded by the Polish National Centre for Research and Development under contracts M-ERA.NET2/2020/1/2021 and M-ERA.NET3/2021/83/I4BAGS/2022.

References

[1] QuickWave Electromagnetic Software: https://qwed.eu/quickwave.html

[2] QWED brochure: “Test Fixtures and Setups For precise measurements of electric and dielectric properties of materials at microwave frequencies”: https://www.qwed.eu/test_fixtures_brochure.pdf

[3] M. Celuch, M.J. Hill, T. Karpisz, M. Olszewska-Placha, S. Phommakesone, U. Ray, B. Salski, "Benchmarking of GHz resonator techniques for the characterisation of 5G/mmWave materials", 51st European Microwave Conference, London 2-6 April 2022, pp. 568-571 (copyright EuMA).

[4] M. Celuch, O. Douheret, P. Korpas, D. Moerman, M. Olszewska Placha, and J. Rudnicki, "Recent Developments in Modelling Software and Microwave Hardware Relevant to the SPDR Imaging of Organic Semiconductors", IEEE MTT-S Intl. Conf. on Numerical Electromagnetic and Multiphysics Modeling and Optimization NEMO, Limoges, July 2022 - accepted version.

[5] M. Olszewska-Placha, A. Masouras, A. Wieckowski, N. Chotza, M. Celuch, "Contactless Device for 2D Imaging and Precise Characterisation of Electrical Parameters of Anode Materials for Battery Cells", 24th International Microwave and Radar Conference, 12-14 Sep, Gdansk, Poland. - presentation.

[6] Discover great EU-funded Innovations: https://www.innoradar.eu/resultbykeyword/qwed

[7] M.Celuch, "2D SPDR Scanner for the Imaging of 5G and energy materials", Finals of the 2021 Innovation Radar Prize, European Commission – Dealfow.eu, Virtual, 21 Oct. 2021.

[8] NanoBat Open Platform by QWED: https://qwed.eu/nanobat2.php