Task Group Proposal: Modelling and Characterisation of Rough Conductive Surfaces

Lukasz Nowicki[1], Malgorzata Celuch[1]

[1] QWED, 02-078 Warsaw, lnowicki@qwed.eu, mceluch@qwed.eu

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Abstract

This work presents initial results from the EUREKA-Eurostars 5G_Foil project [1], which aims to develop industrial screening methods for copper foils used in high-frequency applications. A measurement technique based on the Ruby Dielectric Resonator (RuDR) is validated for the rapid determination of effective microwave conductivity, with results correlated to surface topology parameters. A strong exponential correlation is observed between conductivity and the Developed Interfacial Area Ratio (Sdr), achieving a coefficient of determination of 0.97 [2], while other roughness parameters exhibit weaker correlations. Foil thickness is shown to be irrelevant within the studied range. Measurements were conducted at 13 GHz and 21 GHz [3] using a Vector Network Analyzer to extract Q-factors and determine conductivity through full-wave modeling. The study confirms that smoother surfaces enhance conductivity, with implications for optimizing copper foils for low-loss applications. Future work extends these investigations to higher microwave and mmWave frequencies using advanced resonator techniques, targeting improved copper foil manufacturing for next-generation 5G/6G networks, IoT, and data centers.

References

[1] EUREKA-Eurostars 5G_Foil project, Available [Online]: https://qwed.eu/5g_foil.html
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[3] M. Celuch, T. Devahif, T. Nalecz, J. Rudnicki, "Modeling-Based Methodology for Electromagnetic Screening of Copper Foils for High-Frequency Applications", IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization (NEMO'2024), 12-14 August 2024, Montreal, Canada