RF measurements of materials and devices in Microelectronics Research Unit

Jussi Putaala, Sami Myllymäki, Mikko Kokkonen

Microelectronics Research Unit

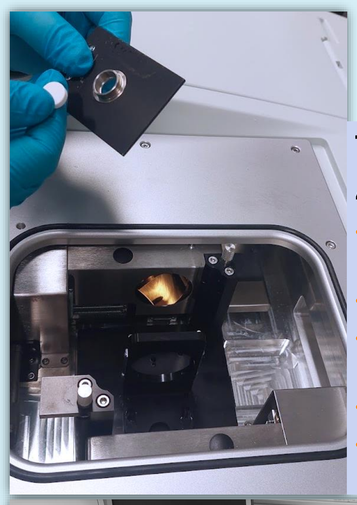
University of Oulu

RF SAMPO

Contact:

firstname.familyname@oulu.fi

RF characterization of materials and devices



TeraView TeraPulse 4000

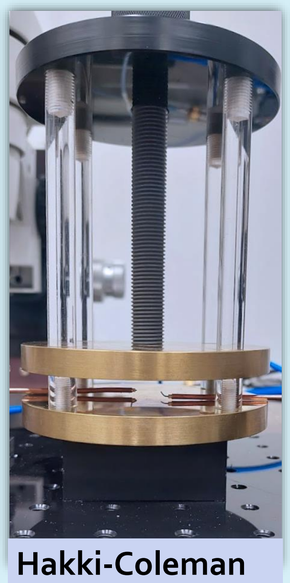
- For solids, powders and liquids
- 80 GHz…5 THz
- Time domain measurements
- Transmission spectrum
- Material permittivity and loss

SPEAG DAK-TL

- Dielectric assessment kit for solids and liquids
- 200 MHz…20 GHz
- Material permittivity and loss
- Motorized measurement head

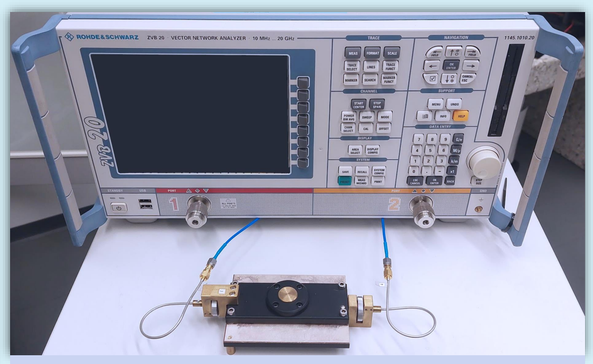
AGILENT E4991A Impedance/ Materials analyzer with test fixtures for dielectric & magnetic measurements

- For solids
- Device capability 1 MHz…3 GHz
- Dielectric & magnetic materials from 1 MHz…3 GHz
  - Permittivity and loss
  - Permeability and loss



Hakki-Coleman dielectric measurement kit

- Resonator method
- High accuracy mm-wave



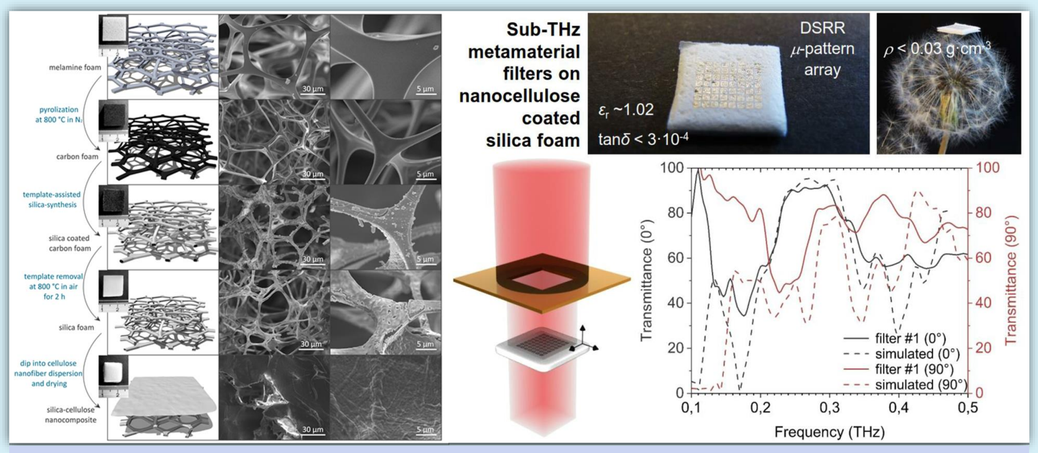
Rohde&Schwarz ZVB-20 VNA

- 10 MHz…20 GHz
- 2-port measurements
- SPDR fixtures
- High accuracy mm-wave

Agilent 8510C VNA + 8517B S-Parameter Test Set

- Device capability 45 MHz…50 GHz
- 2-port measurements on wafer

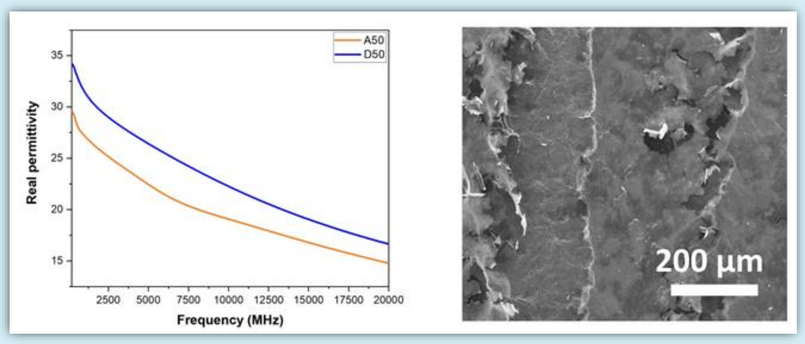
mm-wave and sub-THz operated devices



Silica foams substrates for sub-THz devices

- Ultra low permittivity 1.02 er materials and low losses <0.0003, measured with TeraPulse
- Can be used for any device designs where the metallization needs to be "suspended" into the air, filters, metasurfaces, diffractive lenses (FZP, etc.) etc.

P. S. Pálvölgyi et al., "Lightweight porous silica foams with extreme-low dielectric permittivity and loss for future 6G wireless communication technologies," Nano Res.2021, doi: 10.1007/s12274-020-3201-2.



Shielding material for mm-waves

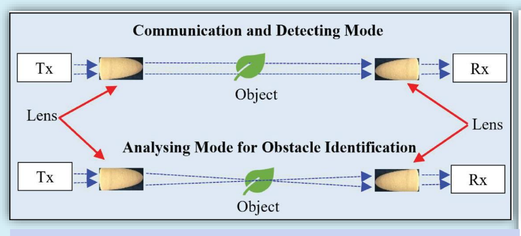
- Measurement result of an interference shielding material up to 20 GHz, measured with SPEAG DAK-TL
- Electromagnetic interference shielding material (cellulose nanofibers, PVA and Ti3C2TX MXene)
- Collaboration with Fibre and Particle Engineering Research Unit

Sami Myllymäki et al., (publication in process)

Radio lenses for sub-THz frequency

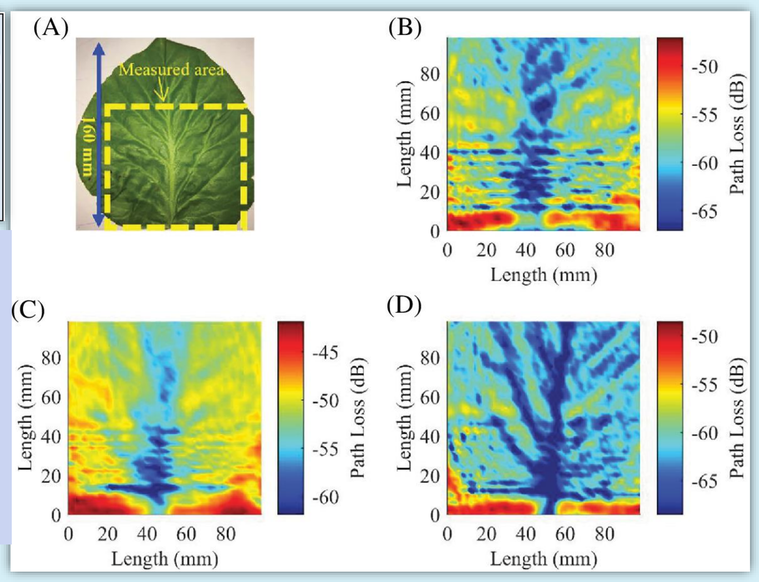
- LMO-HGMS (Lithiummolybdate oxide-glass) lens
- Polymer-BST (polypropylene- $BrSrTiO_3$) composite lenses
- Lenses are used to increase antenna gain and beam steering
- Lens materials for lens antennas

M. Kokkonen, A. Ghavidel, N. Tervo, M. Nelo, S. Myllymäki, and H. Jantunen, "An Ultralight High-Directivity Ceramic Composite Lens Antenna for 220–330 GHz," IEEE Access, vol. 9, pp. 156592–156598, 2021, doi: 10.1109/ACCESS.2021.3130319.

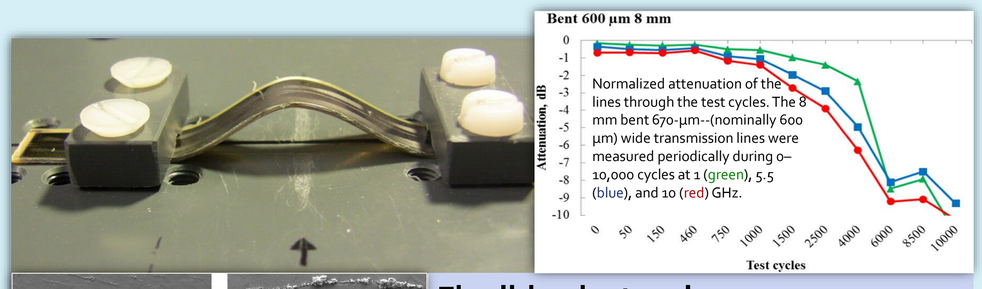


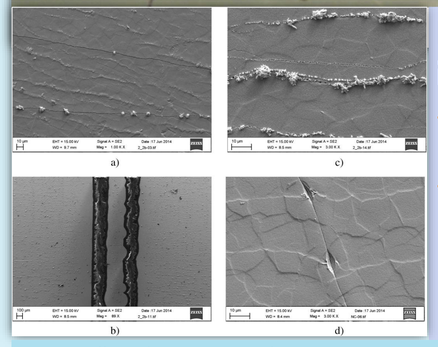
Communication and sensing demonstrator

- 300 GHz wave passed through a leaf and measured field intensity presented in 2D plane (Keysight PNA-X, collaborative work with UOULU's Centre for Wireless Communications (CWC))
- Water in water veins can be easily distinguished from the other parts



Ghavidel, A, Myllymäki, S, Kokkonen, M, Tervo, N, Jantunen, H. Lens antenna adjustment for telecommunication and imaging modes in a sub-THz radio system. Engineering Reports. 2022; 4(3):e12474. doi:10.1002/eng2.12474





Flexible electronics, interconnections and reliability

- Flexible polymer substrate with an inkjet-printed (nano-Ag) CPW transmission line
- Effect of thermal cycling stress in 0…100 °C in the performance assessed in bending position up to 10 GHz using Agilent 8510C + 8517B

Sami Myllymäki, Jussi Putaala, Jari Hannu, Esa Kunnari, Matti Mäntysalo, "RF measurements to pinpoint defects in inkjet-printed, thermally and mechanically stressed coplanar waveguides", Microelectronics Reliability, Vol. 65 (2016), pp. 142-150, https://doi.org/10.1016/j.microrel.2016.08.021.

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