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THz waveguide characterization of amorphous carbon for the Compact Linear Collider

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Amorphous Carbon (aC) is used to prevent or limit the insurgence of an electron cloud in the accelerator vacuum chamber. Since in the Compact Linear Collider (CLIC) small bunches are used, a full electromagnetic characterization of the amorphous carbon conductivity is needed in the high frequency region (millimeter wave range and above), where no literature data are available.
Material characterization at high frequencies usually consists in the study of the electromagnetic response of a standard waveguide where the sample under test is placed or deposited.
This method however lacks accuracy when the material is in thin film form, and it is not very reliable for frequencies exceeding the sub-mm range. Besides that, aC has to be deposited with thickness not larger than 1-2 μm on steel substrate, which makes difficult to extract the material parameters.
An alternative idea is to carry out measurements using a Time-Domain coherent THz Spectrometer (TDS). Under specific conditions, placing a sample in the optical path of the TDS allows to measure the transmission or reflection properties and to retrieve the complex response function. In the case of aC coatings, the simple THz reflection measurement in air usually doesn't provide enough sensitivity to see the difference when the sample is not present. To circumvent this problem, the electromagnetic characterisation of the material can be carried out in a circular waveguide specifically designed, having a very thin central layer where aC is deposited on both sides. This configuration ensures a simple and controlled deposition of the material under test, in contrast with a standard rectangular waveguide. In order to efficiently collect the THz signal, the waveguide is connected to two horn antennas on both sides.
We will present the design and fabrication of the circular waveguide, the study of the best optical configuration in free space and the optimization of data retrieval procedure from the signal transmitted through the waveguide in the frequency range 0.1 –1 THz and above.

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