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# Silk Foam Terahertz Waveguides for Biomedical and Agri-Food Applications

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Silk is a unique kind of nature protein. In recent years this ancient material has been introduced into biomedical field as a promising biomaterial which opened a new era in the development of optical interfaces and sensors for biomedical applications. In this work, we present biocompatible THz waveguides made from silk foam. To our knowledge, this is the first time when biocompatible waveguides are demonstrated in the mid-THz frequency range.
Silk foams were obtained from a purified aqueous silk fibroin solution and lyophilised in a vertical freezer at -80 ℃ for several hours. Density measurements show a porosity (air fraction by volume) higher than 94%. Fiber silk foams are investigated with a THz Time-Domain Spectroscopy setup. We measure the THz transmission through different lengths of samples. We extract both the refractive index and the extinction coefficient in the THz
virtually constant with a value of 1.0654, close to that of air. The losses follow a square law (0.3 cmˆ-1 at 0.3 THz). Because of its high porosity, the absorption losses are reduces by one order of magnitude compared to solid silk. Its main advantage compared to other waveguides is that it is biocompatible, biodegradable and it could be biofunctionalized. Moreover the foam porous structure can be useful for sampling of biofluids using capillary effect for applications in biosensing. This cannot be done with usual THz polymer waveguides.

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