3D Printable Photocurable Polymers and Terahertz: A Pathway to Next-Generation Devices for 6G Technologies.

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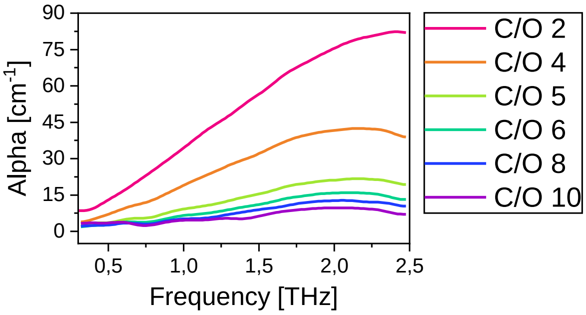
The next generation of wireless communication (6G), foreseen for the 2030s, will be based on terahertz (THz) radiation. 6G is predicted to aggregate multiple types of resources, becoming a digital ecosystem that connects the digital, physical, and human worlds.[1] To achieve this goal, it is thus necessary to minimize the existing gap between cyber and physical worlds, with distributed and adaptive interactions between THz and devices. Beyond 6G, THz frequencies are also gaining interest for many applications in different areas such as biomedical, quality control, security, and defense.[2]

Despite the pivotal role that this part of the electromagnetic spectrum will play in the next future, the knowledge on matter/radiation interaction is lacking, especially for polymeric materials. To address this, experiments on various photocured polymers with different chemical compositions were conducted to understand the relationship between their chemical structure and THz absorption. The materials studied were photocured acrylates, methacrylates, and thiol-ene resins, selected because of the easy tailoring of chemical and physical characteristics by changing the ingredients of the photocurable formulations.[3] In particular, the impact on THz absorption of materials with different chemical components in their molecular structure was assessed. The analyses evidenced a precise relationship between chemical structure and THz interaction, allowing control of THz transparency (Fig. 1a). The definition of this dataset was the cornerstone for the next step, which was the development of devices with user-defined properties. A key-approach is the fabrication of metamaterials, objects in which materials properties and object design play a synergistic role, defining tunable absorbance properties. To obtain this unique interaction, for THz-metamaterials, geometric features of hundreds of microns are necessary. Those characteristics are perfectly compatible with 3D printing capabilities, in particular with Digital Light Processing (DLP) technology (Fig. 1b). Here, Metamaterials were designed using simulation tools and then fabricated via DLP 3D Printing.



a)

b)

Figure 1. a) Absorption coefficient of photocured polymers with different carbon content; b) example of DLP 3D printed object.

References

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