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Fabrication of Textile-Based Radio Frequency Metasurfaces

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Abstract : Radio Frequency (RF) metasurfaces are arrangements of subwavelength elements interacting with electromagnetic radiation. These arrangements affect polarization state, amplitude, and phase of impinged radio waves; for example, metasurface designs are used to produce functional passband and stopband filters. Recent advances in additive manufacturing techniques have enabled the low-cost, rapid fabrication of ultra-thin metasurface elements on flexible substrates such as plastic films, paper, and textiles. Furthermore, scalable manufacturing processes promote the integration of fabric-based RF metasurfaces into the market of sensors and devices within the Internet of Things (IoT). The design and fabrication of metasurfaces on textiles require a multidisciplinary team with expertise in i) textile and materials science, ii) metasurface design and simulation, and iii) metasurface fabrication and testing. In this presentation, we will discuss RF metasurfaces on fabric with an emphasis on how the materials, including fabric and inks, along with fabrication techniques, affect the RF performance. We printed metasurfaces using a direct-write approach onto various woven and non-woven fabrics, as well as on fabrics coated with either thermoplastic or thermoset coatings. Our team also performed a range of tests on the printed structures, including different inks and their curing parameters, wash durability, abrasion resistance, and RF performance over time.

Keywords : electronic textiles, metasurface, printed electronics, flexible
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