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Tailoring Electromagnetic Waves By Simple Water-Based Devices

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Ever since their discovery, Maxwell's equations have been vigorously applied in a large plethora of complex material configurations to characterize their radiation and scattering properties, and to provide explanations of and insights into their physics and potential applications. Many advances have been facilitated by material science and engineering. New materials lead to new physics and to the consequent engineering of new devices. In particular, efforts in the field of metamaterials and metasurfaces have not only furnished functional material platforms that have revealed truly novel and rather exotic properties, but they have also revived and extended the traditional scattering analysis methods. While most initial efforts exploited metals in the proposed platforms, the obvious desire to move the operation to higher frequencies made use of low-loss dielectrics. With respect to the latter, a very appealing avenue has recently turned out to be use of nothing more than water as the main ingredient in platforms for tailoring of microwaves at will. Among the advantages of water are its price, availability, bio-friendly nature and high and easily tunable permittivity. Our talk reviews mostly our own analytical, numerical and experimental efforts on how water can be used to design simple microwave platforms like e.g., metasurface reflect-arrays, dielectric resonator antennas and Huygens antennas, and water-based structures supporting the so-called bound-states in the continuum with huge application potential. While the reviewed water-based devices are truly simple, they facilitate a revival, perhaps a necessary one, of our field by placing mature theories in the context of modern applications.