

Engineered Nanoscale Particles: Building Blocks of Tomorrow's Optical Technologies

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Abstract – Recent advancements in nanofabrications, characterisations, and computer modelling have allowed the generation of arrays of engineered nanoparticles, called meta-surfaces, that extraordinarily control light characteristics. They can reproduce the functions of bulky geometrical optics such as lenses, mirrors or filters. Alongside that, occasionally, metasurfaces can offer some functionalities, such as tunability, that are not achievable by geometrical optics. Such advances have led to revolutionary applications in several fields, including but not limited to meta-lenses, polarisation converters, nano-sensors, and holograms. In this talk, I will briefly review the research activities of the Advanced Optics and Photonics Group at Nottingham Trent University on light-matter manipulation for real-life applications. I will discuss how engineering metallic, dielectric, and semiconductor nanoparticles enable us to control the light intensity, frequency, and propagation direction. I will demonstrate how such controls can help us to generate optical nano-switches with switching time faster than the human eye's response. Also, I will explain how we can engineer nanoparticles to convert images from the near-infrared region, invisible to human eyes, to the visible region. Finally, I will show our latest results on how nanostructures can help monitor individual proteins over time. These are a few examples, among many other technologies that are being developed in the community, of why many people consider photonics at the heart of cutting-edge technologies in the 21st century.