STRONGLY DEFLECTING METAGRATINGS INTEGRATED ON LASERS FOR BIOPHOTONICS

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Flat metaoptics-integrated devices are set to revolutionize compact photonics solutions, offering unprecedented freedom in light manipulation and easing alignment constraints compared to traditional optics. This is achieved through engineered subwavelength nanostructures fabricated using conventional nanofabrication methods. We introduce semiconductor laser-integrated dielectric metasurfaces tailored for biophotonics applications [1]. Specifically, we modified the emission of vertical-cavity surface-emitting lasers by directly fabricating metasurfaces on their emitting facets. Our designed curved GaAs metagratings achieved a fan-shaped emission with a ~60° off-axis deflection in both air and glass, with deflection efficiencies of 90% and 70%, respectively. We demonstrated proof-of-principle total internal reflectance and dark field imaging of Au nanoparticles and cells incubated with them. Our illumination module allows seamless toggling between these modes and, since the laser chip is outside the field of view, it is fully compatible with conventional microscopy setups. Furthermore, we extended these results to the field of biosensing applications. The same integrated illumination platform served to illuminate a Au film interfaced with analyte containing solutions and allowed us to show a miniature surface plasmon resonance-based sensing device (Fig. 1) [2]. These small, portable biosensors exhibited remarkably high sensitivity due to their unique geometry, comparable to state-of-the-art benchtop tools.

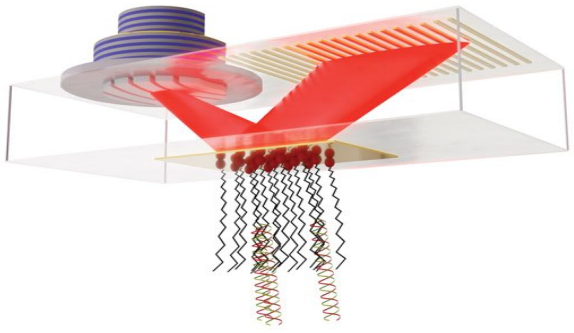

Fig.1 Artistic representation of a chip-integrated illumination solution comprising a metagrating-enhanced laser, applied for biosensing

References

1. M. Juodėnas, E. Strandberg, A. Grabowski, et al. *Light Sci Appl* 2023, 12, 251.

2. E. Strandberg, M. Juodėnas, H. Šípová-Jungová, Mikael Käll. *In Manuscript* 2024.