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In the development of integrated large-scale optical phase array, compact optical nanoantennas are needed. For high resolution arrays, the nanoantenna footprint and the separation between them should be as small as possible to reduce the number of interference orders in the far field [1]. In the development of this nanoantennas in our InP membrane on Silicon (IMOS) platform [2], we use deeply etch focusing grating to reduce the size [3]. In order to increase the optical power emitting up, we add a metal reflector of Silver underneath the semiconductor with a small buffer of 50 nm of SiO_2. This metal layer will also works as a thermal heater, which will change the optical properties of the semiconductor changing the direction of the upcoming light. The last element to be add is a subwavelength ridge which reduces the unwanted Fresnel reflections by reducing the refractive index contrast [3].

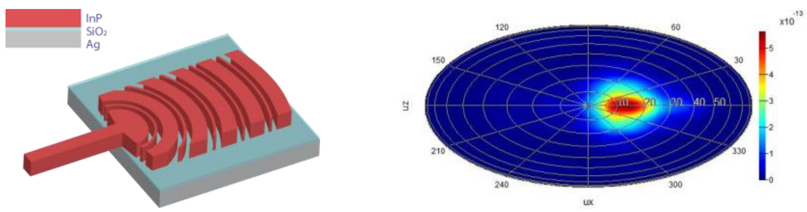

Fig. 1. (a) A schematic of the optical nanoantena, (b) The far-field emission profile .

We simulated the nanoantenna using the 3D-FDTD model. In this case, the commonly 2D-FDTD approximation used in grating simulations is not valid anymore due to the high lateral confinement in the structure. In our 300 nm thick InP membrane, the best grating we got has 5 periods with a pitch of $\Lambda = 880nm$ with a filling factor of 0.52. The subwavelength ridge is 100 nm. Figure 1a illustrated the grating design. We add a buffer layer between the InP and the metal to reduce mode mismatch and therefor, reflections due to the metal. The efficiency obtained at $1.55\mu m$ is 59% of upcoming light and 8% reflections. The far-field emission is centred about 13° from the zenith (Fig 1b). We predict that further optimization could improve this performance. This work was supported by the ERC Project NOLIMITS

References

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