Optical beam steering for wireless optical applications

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As data rates are increasing, the need for high speed, broadband and low-cost components is becoming more and more important, this includes wireless systems. At RF side an evolution is seen from the standard wireless communication at 2.5GHz with limited bandwidth to the 60GHz band. The 60GHz band has a huge unlicensed bandwidth of 5 up to 7GHz. Such systems are currently being researched. Due to the high carrier frequency and strong attenuation, directive systems are recommended. Using directive systems reduces the problems of e.g. attenuation and multipath dispersion.

Another approach lies in the use of optical wireless communication systems. Optical wireless communication has the advantage of a huge unlicensed bandwidth and the possibility of low-cost and low-weight components. The latter is especially the case when following an integrated approach. Such an integrated approach on Silicon-on-Insulator is followed here with the goal of fabricating components sending the light off-chip. Highly directive links are preferable. Since such directive links are prone to misalignment errors, adaptive beam steering is required. Therefore an optical phased array is used.

Optical phased arrays (OPAs) allow very stable, rapid and precise beam steering without mechanical motion, making them robust and insensitive to external constraints such as acceleration. Mainstream OPAs are liquid crystal optical phased arrays (LC-OPAs). These arrays actually act as a programmable blazed grating. Main issues with the LC-OPAs is the problem of relatively large pixel spacing, fill factor, speed, addressing and the so-called spatial flyback, i.e. the liquid crystal needs some space to relax from one state to another.

An integrated component is presented here consisting of a 1D array of sixteen grating couplers. Using the phased array principle, the beam can be steered in one direction, while the beam can be steered in the other direction by means of wavelength tuning. Phased array steering is accomplished with thermo-optic tuning. Silicon has a rather large thermo-optic coefficient making thermal tuning an easy, stable and low-cost solution. A schematic of the component can be found in Figure 1.

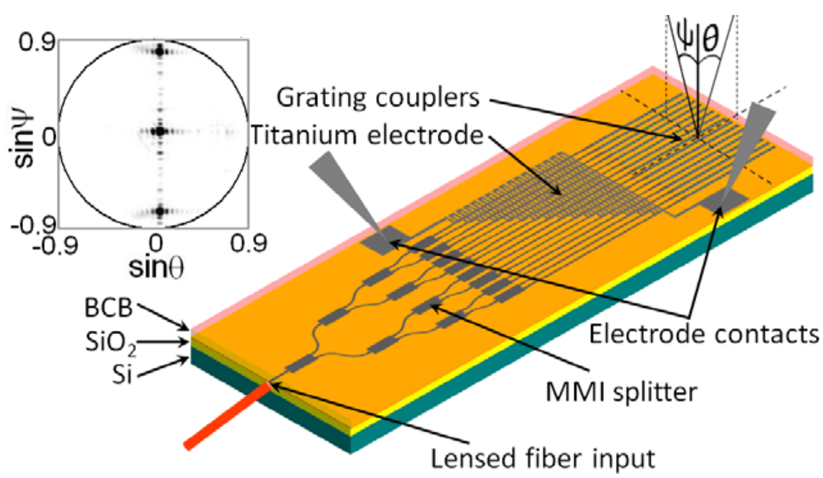

Figure 1: A schematic of the beam steering component. The inset shows the measured far-field pattern.