MASTER THESIS

Surface Plasmon Polariton Modulator Based on Plasma Dispersion Effect

Photonics	
Type of work: - Evaluating the possibility of plasmonic waveguiding in desired structure - 3D simulation in RSoft/CST - Optimizing the component regarding modulation efficiency and bandwidth	**Requirements:** - Basics semiconductor physics - Advanced knowledge in photonics - Independent way of working

Background:

Optical communication provides high bandwidths to deal with today's demand of increasing data rates. It is still part of the research to improve the usage of these entire bandwidths. One limiting factor is the modulation of light with Mach-Zehnder modulators (MZM), which are not able to cover the provided frequency ranges. Using the principle of surface plasmon polaritons increases the bandwidth up to 500 GHz by utilizing the Pockels effect with the help of electro-optical organic compounds. Another electro-optical effect is the plasma dispersion effect, where the refractive index depends on the free charge carriers inside of semiconductors, which leads to modulation of the light. One benefit of this approach is the compatibility with standard CMOS fabrication processes. Hence, it is promising to further investigate this method.

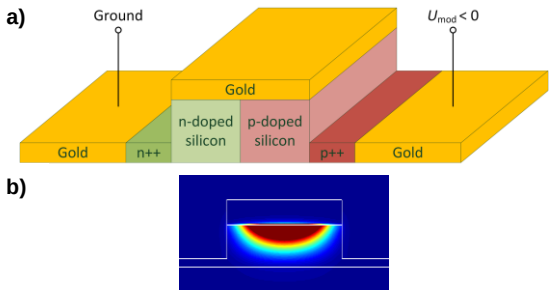

Figure 1: Example of one arm of a Mach-Zehnder modulator, which uses the plasma dispersion effect (a). Mode profile of surface plasmon polariton mode (b).

Task:

One main goal of the thesis is to verify and maintain the possibility of plasmonic waveguiding based on the structure in fig. 1. It is likely, that certain measures in the structure are necessary to accomplish this task. In a next step the modulation efficiency shall be increased by optimizing the doping configuration. At the end, further optimization shall be done with the emphasis on the bandwidth of the modulator.

The thesis may be prepared in English or German.

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