Method

EE, 20182327

Lee Jong Geon

1. Materials and Methods
   1. Materials
      1. OC&ML
      2. CF
      3. DTI
      4. FDTD simulation

OC&ML are composed of SiO2. The OC&ML focus light on CIS. CF is composed of the materials which have high transmittance at red, green, blue and white light each matched CIS. The CF serves to filter the light of the desired wavelength range. DTI is composed of SiO2. The DTI prevent external light from neighbor CISs to the detector area and leakage of internal light.

The CIS simulated by FDTD simulations which is electromagnetic problem solving program from Lumerical Inc. In the program we can set the material to own components. We got the raw data by the four monitors (top, left, right and bottom) which can get transmittance. Also, we use 4ⅹ16 CPU cluster to run the program and can simulate the CIS in 2-dimensional space because of symmetry. Therefore, we can get the result faster.

* 1. Methods
     1. Simulations of CIS
        1. Basic structure
        2. Shift OC&ML and CF
        3. Tilt DTI

First, simulate the basic structure of a CIS which has the normal incidence of light. Second, simulate the CIS which is shifted the OC&ML and the CF. We shift the OC&ML by d1 [nm] with 10 nm step from 450 nm to 550 nm. Also, shift the CF by d2 [nm] with 10 nm step from 200 nm to 300 nm. Lastly, simulate the CIS which is tilted DTI. We tilt the DTI by with 0.5 step from to . Our purpose is making the CIS with tilting DTI has almost same QE such as the CIS which has basic structure.

* + 1. Analysis
       1. Power Flow
       2. QE and Crosstalk

Plot the power flows to figure out the effect of tilting the DTI. Also, we can show how the light move into a detector.

QE is a variable which shows how much desired wavelength light is detected. Crosstalk is a variable which shows how undesired wavelength light or external light from neighbors are detected. We find the optimum setting for d1, d2, and based on the QE and the crosstalk. Assume that T1 is a top monitor, T2 is a left monitor, T3 is a right monitor and, T4 is a bottom monitor. Then, we can calculate the QE by following equation, -T1-(-T2+T3-T4) for all frequency spectra. To calculate the QE of each pixel, in each frequency band, take an average value of them such as QEred is the average from 590 nm to 650 nm, QEgreen is the average from 500nm to 560nm), and QEblue is the average from 420 nm to 480 nm. Crosstalk should be calculated by following equation.

We should find the CIS structure which has high QE and low crosstalk.