Method

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1. Materials and Methods

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

The CIS was simulated by FDTD simulation (Lumerical Inc.) The program allows specification of material properties. We obtained the raw data by the four monitors (top, left, right and bottom) which get transmittance. We used 4ⅹ16 CPU cluster to run the program and can simulate the CIS in 2-dimensional space because of symmetry.

We conducted three simulations, First, simulate the basic structure of a CIS on which light is shone in the normal direction. Second, we simulated the CIS in which the OC&ML and the CF were shifted. We shifted the OC&ML by d1 [nm] with 10-nm increments from 450-nm to 550-nm, and shifted the CF by d2 [nm] with 10-nm increments from 200-nm to 300-nm. Lastly, we simulated the CIS in which the DTI was tilted. We tilted the DTI by with 0.5 step from to . Our purpose to make the CIS with tilting DTI have almost the same QE as the CIS that has basic structure. We plotted the power flows to determine the effect of tilting the DTI, and to show how the light move into the detector.

Our goal is to find the optimal setting for d1, d2, and to maximize QE and minimize crosstalk. If the top monitor is T1, the left monitor is T2, the right monitor is T3, and the bottom monitor is T4. Then

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|  |  | (1) |

for all frequency spectra. To calculate the QE of each pixel, in each frequency band, we took an average value of them: QEred is the average from 590-nm to 650-nm, QEgreen is the average from 500-nm to 560-nm), and QEblue is the average from 420-nm to 480-nm. Crosstalk can be calculated as

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| --- | --- | --- |
|  |  | (2) |
|  |  | (3) |
|  |  | (4) |