Design and Fabrication of Fourier Spectral Filter Array for Multispectral Imaging

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Introduction

- Conventional cameras that use color filter arrays (CFA) only capture the metameric RGB color information.
- Multispectral imaging requires more spectral information beyond the minimal RGB colors. Thus, this technique enables chemical and material identification, and boosts the accuracy of object recognition.
- However, acquisition of the multispectral data still remains a challenge for many applications, especially in portable inexpensive systems. In addition, the traditional thinking behind multispectral imaging systems focuses on using narrow band filters to capture the spectral content of a scene, which necessitates different filters to be designed for each application.
- We have demonstrated a new concept of Fourier multispectral imaging by using filter with sinusoidally varying transmittance for a wide range of multispectral imaging applications.

Fabrication Method

- We used the combination of photolithography (EVG 620 mask alignment system) and magnetron sputtering deposition (Denton Vacuum Explorer 14 RF magnetron sputtering system) to fabricate the SFA.

Experiment setup

- To achieve a single-shot image capturing capability, our goal is to make those bulk filters into pixels. The designed 5-channel pixel filter array is shown.

Fabrication Process Flow

1. Design and fabrication of 6 set of masks
2. Clean glass substrate
3. Photoresist layer spin coating
4. UV exposure under aligned mask
5. Remove photoresist from exposed area (positive photoresist)
6. Thin film deposition by physical vapor deposition
7. Lift-off process to remove the coating on photoresist
8. Fabricated all channels? No Yes
9. Clean the glass containing multichroic filter array

One Cycle of Fab Process

1. Exposure
2. After Development
3. ZnS thin film deposition
4. After Lift-off Process

Fabricated SFA

Spectra of Each Channel

(a) 0.5 Period
(b) 1 Period
(c) 1 Period
(d) 2 Period

20X Magnification