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Although 3D image display technologies has been introduced into market for several years, because of its high cost and inconsistent image quality, 3D image display still not common in the market.

In our project, 3D grayscale images on optically rewritable (ORW) e-paper are experimented. It is a cost-effective approach with its good quality and brightness, high contrast, wide viewing angle and rewritable properties, 3D ORW e-paper may become the new trends on 3D Full color displays.

### Project Overview

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### Methodology

#### Project Plan:
- Our goal is to make 3D Grayscale Optically Rewritable E-paper (3D ORW E-Paper).
- We need to prepare two ORW LC cell layers which are coated with two different substrates. They are Polyamide 3744 (PI which is treated as a passive material) and Sulfonic azo dye (SD1 which is treated as an active material). These two materials have different reactions when exposed to polarized light. For SD1, when it is exposed to polarized light, the aligning layer can change its alignment direction due to its non-uniform probability distribution. On the other hand, for PI, when it is exposed to polarized light, the aligning layer can keep its direction. Therefore, we can obtain twist angle in the ORW LC cell and decide the transmission of light into the film after coating these two materials, PI and SD1 onto 2 ORW LC cell layers. After making 2D Grayscale ORW E-paper, we have to use various liquid crystal technologies in order to create 3D ORW E-Paper. We use two same but overlapping images which are optically written on the cell with a slight position shift and different alignment configuration. Therefore, the light will be transfer into left and right circular polarization for each image by putting a quarter wave plate onto the cell.

#### Writing 3D grayscale image on ORW E-Paper:
- Print a 8 bits grayscale image on a transparent film by inkjet printer;
- Put this transparent film on the ORW e-paper;
- Use polarized UV lamp to write patterns on the sample.
- Expose the cell under the polarized UV light at +45 degree with the mask to write left eye image on the ORW e-paper cell;
- Erase the cell to 0 degree with 100um grating in order to write right eye image at odd columns. Now we keep left eye image at even columns.
- Expose the cell to -45 degree with 100um grating and image mask together to rewrite right eye image at odd columns on the ORW e-paper cell.

#### Implementation Phase:

1. Clean the glass by washing machine and cut the glass plates and UV o-zone cleaning.
2. LED Blue light is passed through polarizer at 45 degree with respect to the aligning direction of the bottom line by line mask with 50um width is placed below the polarizer so that the polarized light passes the mask before reaching the cell.
3. Put the glass substrates on the middle of spin coater holder and drop liquid materials (PI) on one surface and (SD1) on another surface.
4. Soft baking PI and SD1 substrates at by hot plate and then hard baking PI substrates by oven.
5. Rub the surface of PI substrates and blow spaces on the surface.
6. Put the glass glass by spin solution of polyimide and polyamide film on the glass plates and UV e-paper cell.
7. Expose the substrates on the column 1 as shown in the picture and then develop PI and SD1 substrates by mask.
8. Erase the substrate of SD1 with polarized UV lamp to align the orientation of SD1 molecules to be perpendicular to the polarization of UV lamp.
9. Assemble PI and SD1 substrates and sealed by AB glue.
10. Line by line mask with LED blue light cut the polarizer to check the polarization light, then aligning the cell.