

Imprinting lithography for flexible transparent plastic substrate by using copper mould in mass production

Suphansa Lieotrakool
Supervisor: Paul Morantz

Project Aim and Objective

Project aim: Investigate the possible efficiency approach to imprint patterns on PET plastic thin film for mass production with high fidelity by using copper mould. Therefore, the objective is set as following:

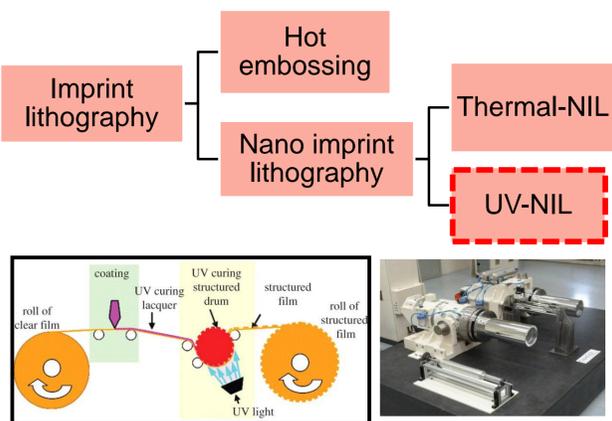
- 1) Identify possible technologies that is employed to imprint pattern onto the plastic thin film efficiently
- 2) Design and conduct experiments to evaluate and determine the effect of UV exposure time and resist viscosity

Background

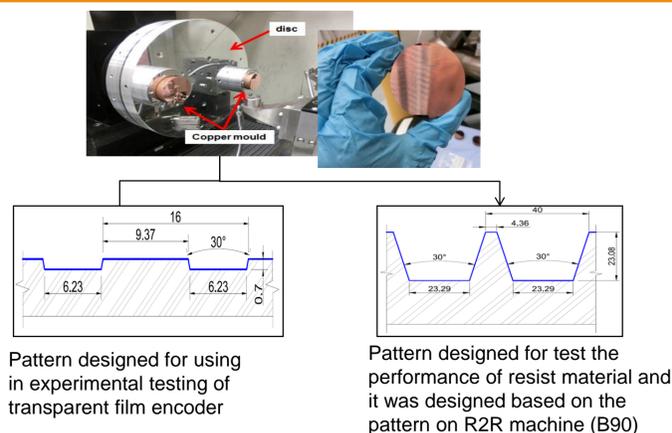
Many products nowadays seem to be smaller and more complex in different application. Therefore, patterns on the substrate must be accuracy in terms of positions and features. In recently, Roll-to-Roll UV imprint lithography have been developed into different directions to meet the mass requirement of demand. And the imprint section is the most important part in the R2R systems because it has a high influence to the fidelity of imprinted pattern.



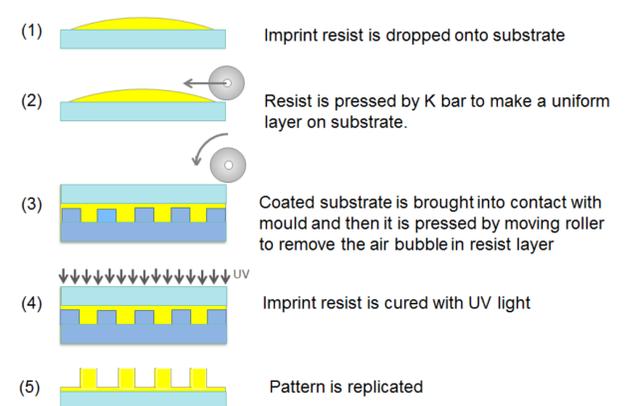
Literature review



Mould fabrication



Imprinting process



Result and discussion

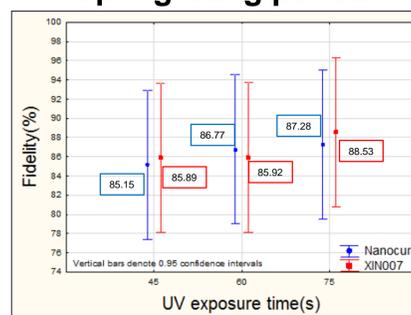
		16 µm	40 µm
Copper mould	Top view		
	Cross section		
Plastic replication	Nanocure (30-70 mPa.s)	Top view	
		Cross section	
	XIN007 (650-800 mPa.s)	Top view	
		Cross section	

The fidelity of imprinted patterns can be controlled by adjusting the exposure time of UV light source, however, this depends on the type of UV curable resist. Using the higher viscosity of resist, more time need for resist to flow and curing.

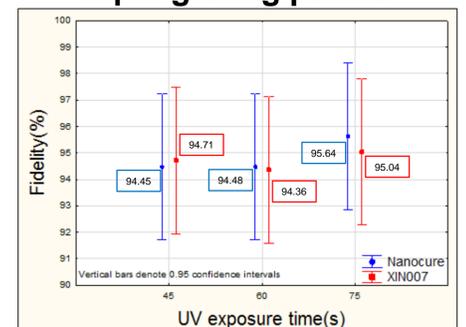
The diagram to the left shows the optical view of the structural cross section, comprised of 2 different grating period with optimal condition to obtain the highest fidelity. It is represented at UV exposure time of 75s (Intensity of UV light source is 68 mW/cm²).

The line graph below showed that for 16µm and 40µm period, the fidelity of the pattern reached almost 89% and 96% respectively.

16µm grating period



40µm grating period



Conclusion

In summary, the UV imprint lithography has demonstrated a efficiency approach to produce micro trapezoid patterns that are particularly beneficial for performing patterning on flexible plastic substrate. It was experimentally shown that increasing UV exposure time can increase the fidelity, which have minimal changes. Moreover, the pattern with 16µm period and 0.7µm step height showed a good repeatability which means optical encoder can be used to indicate film position.



Fidelity of the pattern accessed

by $\frac{\text{Flat portion of imprinted pattern area on plastic film}}{\text{Flat portion area on the copper mould}}$

Future work

- Design and evaluate other factors such as pressure, web speed and initial resist thickness regarding R2R imprinting process to indicate factor which has the most influence factor on pattern fidelity.