

The Study on Fabrication of Two-Dimensional Photonic Crystal in THz Range Using Ultra Deep X-ray Lithography Technique

Student: Han-Chieh Li

Advisor: Chang-Pin Chou
Bor-Yuan Shew

Institute of Mechanical Engineering
National Chiao Tung University

The study is using the high-sensitivity and high-contrast SU-8 as the X-ray resist to develop a high-efficiency, high-yield, and high-quality ultra-deep X-ray lithography (UDXL) technique. This technique will be used to fabricate a Two-Dimensional Photonic Crystal in THz Range. The study also combines the theory to fabricate a high pass filter in practice, and using optical measurement to detect the application of the technique. Expect to support the advanced research of the THz photonic crystal, the result of the study can be applied to the micro system technique. For instance, it can be applied to the research of micro-machine, micro-fluid, micro-actuator and micro-wave components.

The results showed the quality can be enhanced by putting in air before baking. Increasing the oxygen pressure can reduce the time putting in air. This study finds technique to overcome the collapse problem by building up the top frame structure on the top of the structure. The technique can be used to fabricate the micro structure which has the higher height and the smaller space.

Based on the established capability in this study, a THz two-dimension photo crystal which have a 1000 μm thick, radius of 15 μm and lattice constant of 170 μm was successfully fabricated. The results showed that the DXL SU-8 technique could provide excellent pattern-transfer quality with high precision ($\sim 1\mu\text{m}$) and high accuracy ($< 1\mu\text{m}$). The sidewall is quite perpendicular to the substrate with an inclined angle of only about 0.03° . The results of optical simulation and optical measurement also showed that the THz two-dimension photo crystal can filter the electromagnetic wave in low frequency and conformed to the demands as a high pass filter.