Figure Caption

Fig. 1.1 CP-HN-38 circular polarizer 2

Fig. 1.2 Ambidextrous polarizer 2

Fig. 1.3 Wire-grid Polarizer 4

Fig. 1.4 Wollaston Prism 6

Fig. 1.5 MacNeille polarizing beam splitter cube 8

Fig. 1.6 Polarized light separation of a sub-wavelength grating 9

Fig. 2.1 A dielectric grating 13

Fig. 2.2 Schematic of a laminar zero-order grating（ $p << \lambda$ ）with the orientations of the incident electric wavefield and definitions of rectangular grating parameters 14

Fig. 2.3 Diagram of $n_{//}$ and $n_{\perp}$ versus fill factor f 18

Fig. 2.4 Coordinate definition for deriving effective refraction indices 19

Fig. 2.5 Structure of double-layered sub-wavelength grating 25

Fig. 3.1 (a) Schematics, and (b) photograph of an electron beam writer 29

Fig. 3.2 Under-cut of PMMA 30

Fig. 3.3 Flow of fabricating single-layered sub-wavelength grating 33

Fig. 3.4 Flow of fabricating sub-wavelength grating with double-layer structure by using tri-level resist system 35

Fig. 3.5 Schematic diagram of conventional RIE system 36

Fig. 3.6 Schematic diagram of high-density-plasma ICP-RIE system 37

Fig. 3.7 Flow of fabricating sub-wavelength grating with double layer by using

ICP-RIE process …… 39
Fig. 3.8 Schematic diagram of scanning electron microscope …… 40
Fig. 3.9 Concept of AFM and the optical lever …….. 41
Fig. 3.10 Schematic diagram of the experimental setup for the characterization of the fabricated sub-wavelength grating …….. 43

Fig. 4.1 Simulated results of p ray transmission efficiency versus wavelength of incident light with various periods of the sub-wavelength grating …… 49
Fig. 4.2 Simulated results of s ray reflection efficiency versus wavelength of incident light with various periods of the sub-wavelength grating …….. 49
Fig. 4.3 Simulated results of p ray transmission efficiency versus wavelength of incident light with various thicknesses of metallic layer ……... 51
Fig. 4.4 Simulated results of s ray reflection efficiency versus wavelength of incident light with various thicknesses of metallic layer ……. 52
Fig. 4.5 Simulated results of p ray transmission efficiency versus wavelength of incident light with various duty cycles of grating …….. 53
Fig. 4.6 Simulated results of s ray reflection efficiency versus wavelength of incident light with various duty cycles of grating …… 54
Fig. 4.7 Simulated results of p ray transmission efficiency versus wavelength of incident light with various materials of metallic layer ……... 56
Fig. 4.8 Simulated results of s ray reflection efficiency versus wavelength of incident light with various materials of metallic layer ……. 56
Fig. 4.9 Resonance wavelength of the sub-wavelength grating with metallic layer only and period of 0.2 μm …… 58
Fig. 4.10 Simulated results of p ray transmission efficiency versus wavelength of incident light with various thickness of dielectric layer …….. 60

Fig. 4.11 Simulated results of s ray reflection efficiency versus wavelength of incident light with various thickness of dielectric layer …… 60

Fig. 4.12 Simulated results of p ray transmission efficiency versus wavelength of incident light with various materials of dielectric layer …….. 62

Fig. 4.13 Simulated results of s ray reflection efficiency versus wavelength of incident light with various materials of dielectric layer …… 62

Fig. 4.14 Comparison of p ray transmission efficiency between single layer and double layer …… 64

Fig. 4.15 Comparison of s ray reflection efficiency between single layer and double layer …… 64

Fig. 5.1 Film thickness versus spin speed for 495k MW PMMA in anisole with concentration of (a) 2%, 4%, and 6%, and (b) 8% and 11% …….. 67

Fig. 5.2 Film thickness versus spin speed for 495k MW PMMA in chlorobenzene with concentration of (a) 2%, 4%, and 6%, and (b) 8% and 9% 67

Fig. 5.3 Film thickness versus spin speed for 950k MW PMMA in anisole with concentration of (a) 2%, 4%, and 7%, and (b) 9% and 11% 67

Fig. 5.4 Film thickness versus spin speed for 950k MW PMMA in chlorobenzene with concentration of (a) 2%, 4%, and 7%, and (b) 9% and 10% 68

Fig. 5.5 Designed pattern for dose test …… 69

Fig. 5.6 Tested results of line dose of electron beam …… 72

Fig. 5.7 Photograph of the exposed PMMA ……... 74

Fig. 5.8 Top view of the fabricated sub-wavelength grating observed by SEM with magnification of (a) 1.1k, (b) 11k, and (c) 40k …….. 75

Fig. 5.9 Cross-sectional view of the fabricated grating observed by (a) SEM and (b) AFM ……... 76

Fig. 5.10 Definition of polarization angle …….. 77

Fig. 5.11 Comparison of measured and calculated results of reflection efficiency versus polarization angle ……. 77

Fig. 5.12 Comparison of measured and calculated results of reflection efficiency versus wavelength of incident light ……. 78

Fig. 5.13 Etched results of tri-level resist system ……... 81

Fig. 5.14 Etched result of aluminum layer by using ICP-RIE with $Cl_2/CH_4/Ar$ …… 83

Fig. 5.15 Etched results of aluminum layer by using ICP-RIE with Cl_2/BCl_3 ……... 84

Fig. 6.1 Schematic layout of a conventional backlight module ……. 86

Fig. 6.2 Schematic layout of an integrated lightguide …… 87

Fig. 6.3 Schematic layout of an liquid crystal projector …… 88

Fig. 6.4 Schematic diagram of a pickup head …… 89