Martin P. Aalund

HW 1

Optomechanics

Problem 1E). Taken from Hoy Master Optics Glass.xls and Glass data sheet http://www.hoyaoptics.com/

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| Description | Symbol | Meaning |
| Refractive Index to five decimal places | nt,ns,…….ni | Index at individual wavelengths from 1014nm to 365.01nm |
| Abbe Number | Vd, Ve, nf-nc, nf-nc’ | Measure of dispersion for different frequency ranges. |
| Constants of Dispersion formula  n2 = A0 + A1λ2 + A2λ-2 + A3λ-4 + A4λ-6 + A5λ-8 | A0, A0pow, A1,….. A5pow | Coefficients for a polynomial that will allow you to calculate refractive index at a given wavelength to +/- 5x 10-6 nm over a range of 365nm to 1,014nm |
| Relative Partial Dispersions | PA’,t, Pr,A’,…P’I,h | The relative partial dispersion Px,y and the alternate relative partial dispersion P’x,y are defined by the following equation: Px,y=(nx-ny)/(nF-nc) and P’x,y=(nx-ny)/(nF’-nc’). X and Y are the standard spectal lina assignments. When plotted against Abbe number to compare glasses. |
| Deviation of Relative Partial Dispersions ∆P from the "Normal Line" | ∆Px,y | Values referenced to a straight line defined by the Px,Y values found for the glass types C7 and F2 |
| Chemical properties | DW, DA, Tblue DNaOH, DSTPP, D0 | DW: is dimming: Clouding of glass due to humidity causing white spots.  DA: Acid durability  Tblue: Adjustment to DA test due to inaccuracy in test modeling ION exchange process.  DNaOH: Latent scratch resistivity Hydroxyl ion  DSTPP: Latent Scratch resistivity to polymerized phosphoric ions  D0: intrinsic chemical durability |
| Thermal Properties |  | Tg: Transformation temperature. Glass to liquid transition temperature.  Ts: Sag Temperature point where thermal expansion stops increasing and starts decreasing.  T10x: Temperature required to relieve internal stress after a given time, anneal or soften.  : Coefficient of Linear Thermal Expansion  : Thermal conductivity  CP: Specific heat |
| Mechanical Properties |  | Hk: Knoop Hardness, resistance to surface penetration  FA: Abrasion Factor, measure for lapping  E: Young’s Modulus of elasticity  G: Shear Modulus  : Poisson’s Ratio  b :Flexural Strength (Modulus of Rupture) |
| Electrical Properties |  | Co: Capacitance  v: Volume resistivity at 20 and 200 C. |
| Temperature Coefficients of Refractive Index (10-6/K at 632.8nm) | **(∆n/∆T)rel.**  **(∆n/∆T)abs.** | Used to adjust refractive index due to temperature changes. |
| Stress Optical Coefficient | B |  |
| Specific Gravity | d | Ratio of density of glass to water |
| Bubbles and Inclusion |  | Total cross sectional area of bubbles mm^2 in 100ml of glass |
| Color | λ80/λ5 | L Signifies special glass that have less coloration |
| Internal Transmittance λ (nm) | T | Measure of transmittance at different thickness and wavelengths |
| Melting Frequency | MA, A, B, C | MA highest, A Higher, B Low, C Very Low |
| Production Method | DP, RP | Direct vs reheat press |
| Price | Numeric | Relative Price comparison |

Problem 2) Rules of Thumb

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| **Name of rule** | **Index of Refraction** |
| **The rule of Thumb** | Index is never less than 1 |
| **When it is Used** | Always |
| **Limitation** | Does not apply to some new Meta-materials |

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| **Name of rule** | **Color of light** |
| **The rule of Thumb** | Color of light is determined by the EM wave’s frequency. |
| **When it is Used** | Always when describing aspects of systems that are affected by the color of EM waves. |
| **Limitation** | None , Optics often used wavelength but it is not a constant when n changes along the path |

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| **Name of rule** | **Geometric optics** |
| **The rule of Thumb** | Can ignore wave property of light treat as particle (i.e. ray trace) |
| **When it is Used** | λ << feature size |
| **Limitation** | When high accuracy is required |