Synthesis of highly refractive and transparent poly(arylene sulfide sulfone) based on 4,6-dichloropyrimidine and 3,6-dichloropyridazine

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High refractive index polymeric materials have been rapidly developed and attract significant interest in recent years. They were used in lenses, prisms, components for charge-coupled devices [1] and complementary metal oxide semiconductor image sensors [2] because of their lightweight, impact resistance, processability, and dying ability compared to inorganic glasses. A general approach for increasing the refractive index of polymers is the introduction of substituents with a low molar volume and high molar refraction. The sulfur element is commonly selected because of its high polarizability, stability, and facility to introduce to polymers. Such as aromatic polyamides (PAs) [3,4] and polyimides (PIs) [5,6] containing high content of sulfur elements. Although they exhibit high refractive index in the range of 1.7-1.77, their films have large birefringence and coloration (That is resulted into coloration of aromatic PAs and PIs for its formation charge transfer complexes (CTC) between the electron-donating diamine and the electron-accepting carbonyl group), which are the problems of aromatic PAs and PIs. Thus, in order to enhance the refractive index and optical transparency of polymers, a kind of poly(arylene sulfide sulfone) (PASS) containing pyrimidine (or pyridazine) unit has been developed with the molecular design method in this study. The polymer was prepared by a polycondensation reaction of 4,4'-dimercaptodiphenyl sulfone (DMDPS) and 4,6-dichloropyrimidine (DCPM) (or 3,6-dichloropyridazine (DCPD)). They showed good thermal stabilities such as a relatively high glass transition temperature of 193-202 ^{o}C and a 5% weight-loss temperature ($T_{5\%}$) of 370-372 ^{o}C. The optical transmittance of the polymer at 450 nm is higher than 81%. The heterocycles unit and plural -S- linkages provides the polymer with a high refractive index of 1.737-1.743 at 633 nm and a low birefringence of 0.003-0.004. Moreover, the synthesis of the DMDPS is more facile and affordable than the other monomers reported for sulfur-containing polymers. Thus, the PASSs can be good candidates as components for advanced optical device applications, such as optical wave guides for CMOS image sensor.

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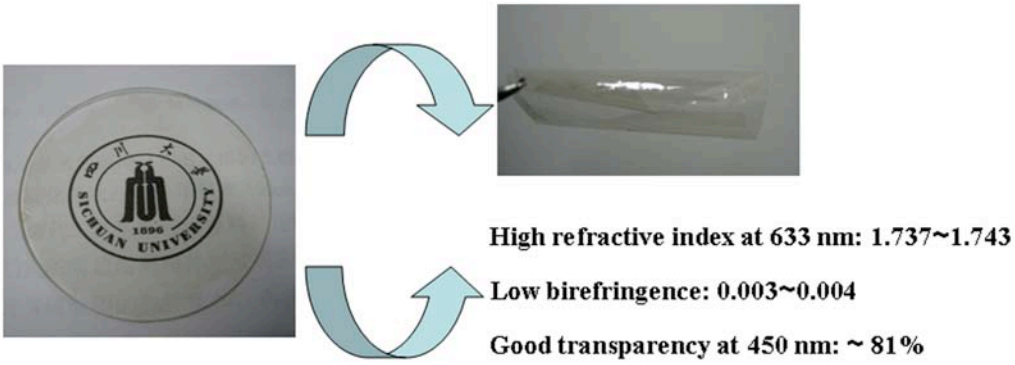

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