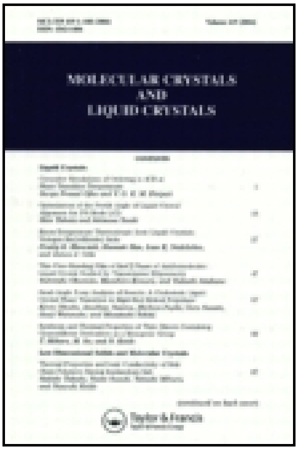

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The Development of Polyacrylate and The Fabrication of Optical Waveguides

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The Development of Polyacrylate and The Fabrication of Optical Waveguides

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We have developed aromatic polyester (polyarylate) for the optical devices. New polyarylate (PAR-A, PAR-B) are excellent for transparency in the visible spectrum, and thermal stability. We found that the birefringence of PAR-A is very low. PAR films are produced easily by spin-coating or solution-casting, and can be patterned by RIE method. We fabricated ridge waveguides patterned in new polyarylate.

Keywords: polyarylate; heat-resistant; low birefringence; optical waveguide

INTRODUCTION

Optical waveguides are essential for optical fiber communication. They are used in optical interconnections, for example, intra chip, chip to chip, and board to board. But inorganic optical waveguides are very expensive. On the other hand, polymer films can be formed easily by spin-coating, since they are solved in a lot of solvents. So, polymer waveguides can be fabricated on larger substrates at low cost, and they are flexible attractively[1]. However, most of polymers are not heat-resistant enough for the optical devices. Therefore, we have developed new polyarylate, which are excellent for transparency and thermal stability.

Fabrication of Optical Waveguides patterned in PAR

Fig.1 is the structure of U-100, well-known for commercial polyarylate. U-100 is amorphous polymer, and excellent for transparency. We have developed new polyarylate, PAR-A and PAR-B, to be modified molecular structure. They are high-Tg polymers. PAR-B is 237 ℃, and PAR-A is 288 ℃. Moreover, We measured refractive index of PAR-A at 633nm at room temperature after heating the films at 100 ℃. As a result, refractive index did not

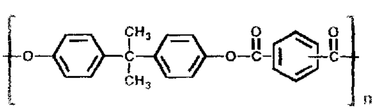

FIGURE 1 structure of U-100

change after annealed. So, we can expect to use this polymer in hot environments.

To understand anisotropy of PAR, we measured in-plane orientation by prism-coupling method. As results, we found that the birefringence of PAR-A is very low. Comparing PAR-A and PAR-B, refractive index of PAR-A is high, and PAR-B is low. Refractive indices of polymers change to be copolymerized these polymers as fig.2. So, we can control refractive indices of core and clad in optical waveguides.

To fabricate inorganic waveguides, clad and core layers are produced by Flame Hydrolysis Deposit. But this method is very expensive. On the other hand, polyarylate can be dissolved in conventional solvents. So, we can prepare polymer films easily by spin-coating at low cost.

We can etch PAR films deeply by reactive ion etching(RIE) with oxygen, and etching depth is proportional to etching time. We confirmed to be able to take advantage of RIE method to pattern PAR films.

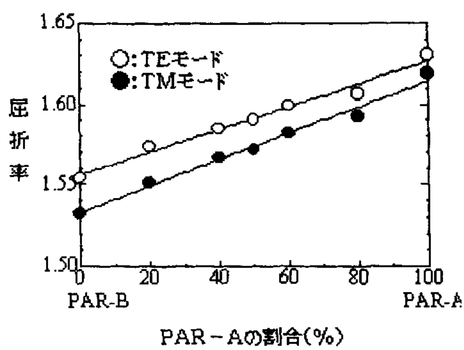

FIGURE 2 Control of refractive inde

By conventional method[2], we fabricated ridge waveguide. Core size was 8 μ m, which is corresponding to single mode optical fiber. Next, we produced ridge waveguide whose core size was large (Fig.3). We used solution-casting film instead of spin-coating film. Core size was about 25 μ m. This size is corresponding to multi mode optical fiber.

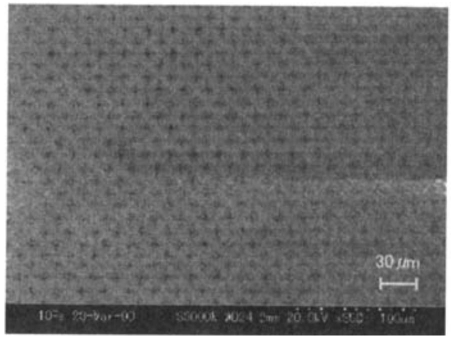

FIGURE 3 Ridge waveguide patterned in PAR-A

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