Formation of barrier ribs for PDP by injection molding method

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Abstract

Paste micro-injection molding process was applied for fabrication of barrier ribs of PDP in an attempt to reduce processing steps and materials loss during the processing. For the paste, a thermally curable one was used and for the mold, a polymeric soft mold was used. It was demonstrated that the micro-molding process can be used successfully in producing barrier ribs of PDP.

1. Introduction

With advancement of information technologies, large-area displays with thinner and larger area dimensions are increasing in demands. For such applications, PDP has been considered to have most merits compared with other types of displays, which include such as large viewing angle, thinner section, excellent picture qualities, and low costs.

As the morphology and dimension of barrier ribs in PDP influence the luminance efficiency, contrast ratio, and resolution, a significant research efforts have been directed to develop a process that could replace conventionally used powder blasting process. The authors have reported previously a possibility of applying paste injection molding process in the fabrication of the barrier ribs [1]. In this process, barrier ribs are formed through molding slurry into cavities of polymeric mold by applying external pressure. The polymeric mold was prepared by rolling a polypropylene film with a grooved roll. This process has a merit of an one-step processing, reducing the processing cost and materials loss significantly.

In this study, panels were manufactured using the rear plate produced by the micro-injection molding process. Luminance of the panel having strip type barrier ribs was measured.

2. Experimental procedure

The mold for the injection molding was prepared by plastically deforming a polypropylene film with a grooved roll. The groove of roll has the same shape of barrier rib and its dimensions were 50 μm in width, 130 μm in height and 250 μm in pitch. The polymeric film used was 500 μm thick. In the preparation of the polymeric mold, the rolling temperature was 130°C, the speed was 0.67 mm/sec, and the load was 40 kfg.

The mold produced by the rolling process was flipped over onto soda lime glass substrate and clamped in a container. The paste used for this experiment consists of glass frit, filler((Al_2O_3), and organic additives. Commercially available glass frit and alumina filler were used. The glass frit and filler was mixed at a ratio of 5 to 1 by volume. For the organic additives, low viscosity epoxy, curing agent, and diluent were used.

After the paste micro-injection molding, the sample was released from the container and heated to 120°C and kept at the temperature for 30 minutes in an oven for curing reaction. After the barrier ribs were cured, the mold was removed from the sample and the sample was heated to sintering temperature, 570°C, at rate of 5°C/min for densification. The sintering time was 30 minutes. After the sintering process, the rear plate was coated with green phosphor. Front plate was formed following conventional processing steps: ITO etching, bus electrode formation, dielectric layer printing and sintering, followed by MgO layer deposition. The front and rear plates were bonded with a sealing glass frit paste. The sealed panel was evacuated and filled with Ne-4%Xe gas.

3. Results and Discussion

3.1. Fabrication of rear plate

Figure 1 shows the pressure versus molding time curve with the pastes of different viscosities. Initially, the pressure was increased until the all the mold cavities were filled with the paste. After the cavities were filled, the molding pressure remained constant throughout the molding process. The molding pressure was in a range of 1.3~1.6 kgf/cm^2 with the paste of 3200-4200cP viscosity. The micro-injection molding was possible at fairly low pressures.

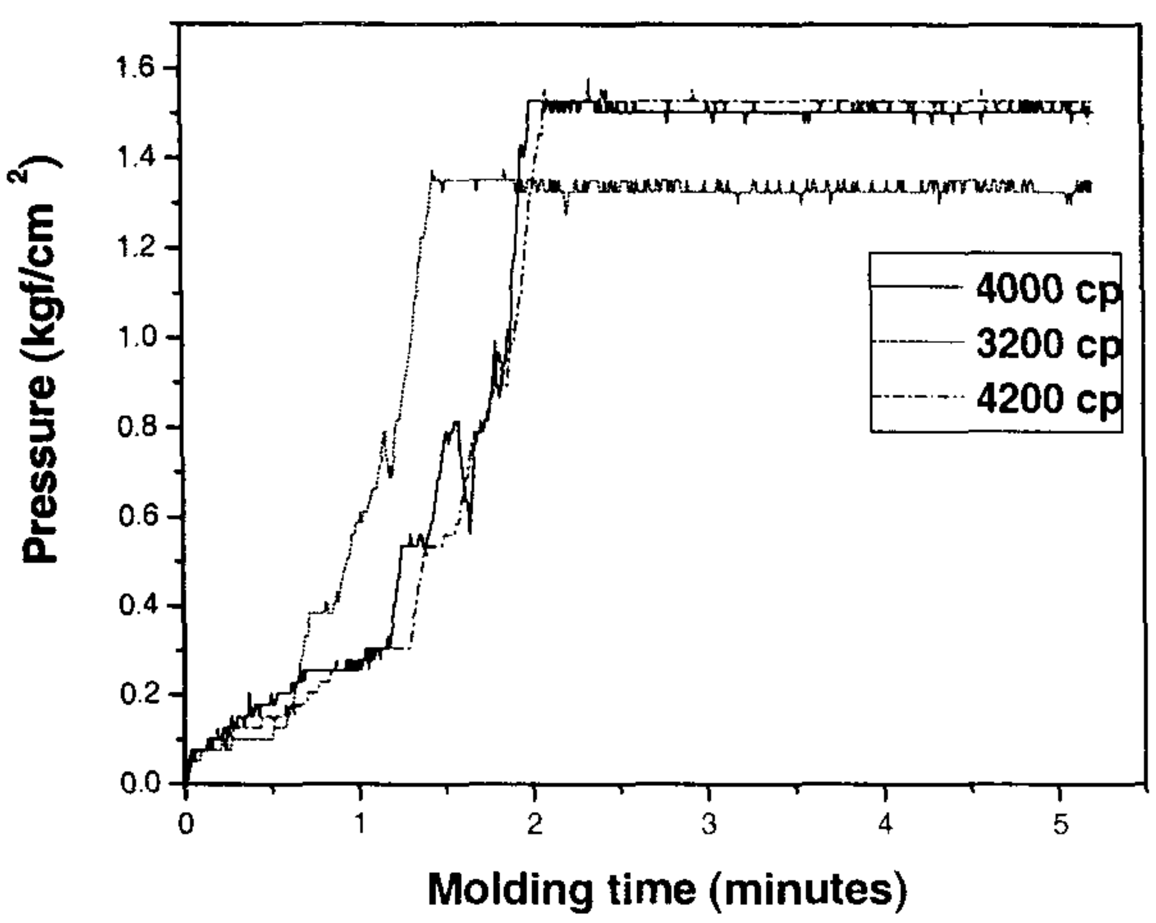


Fig. 1. Pressure versus molding time variation during micro-injection molding process.

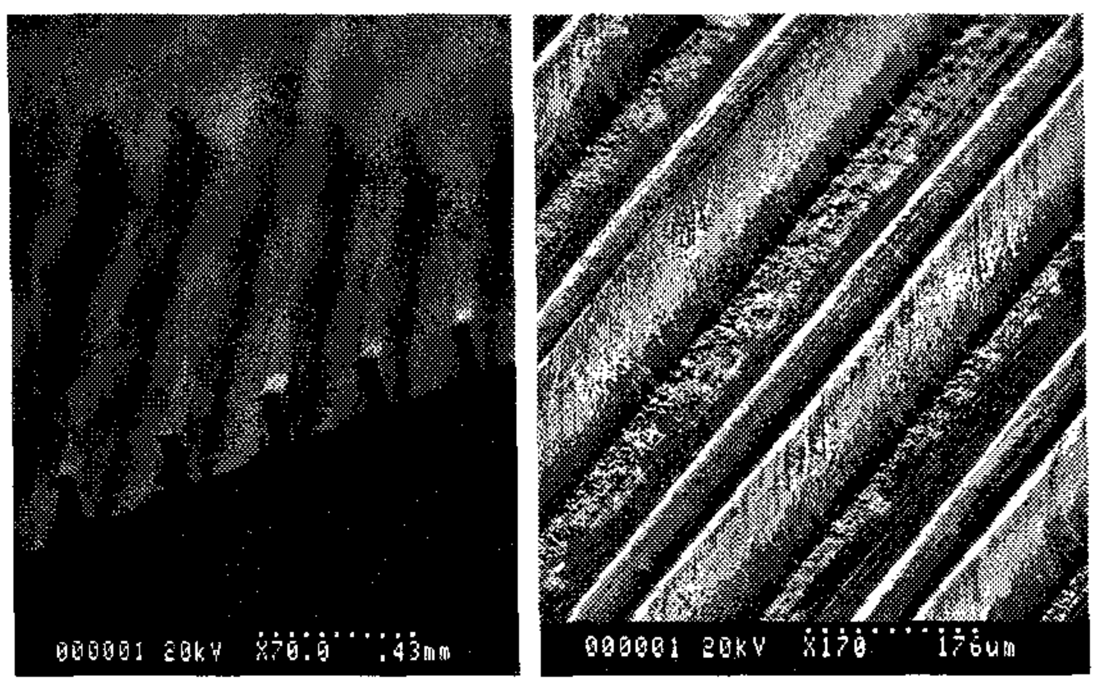
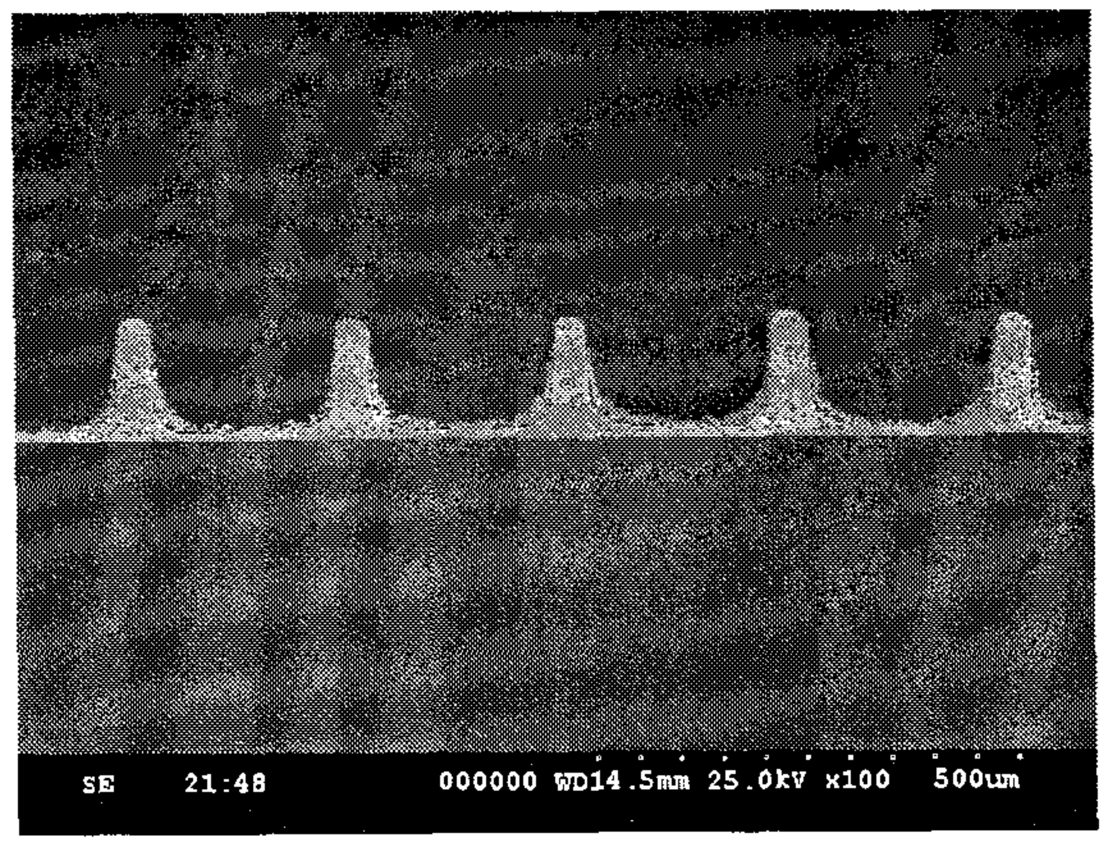


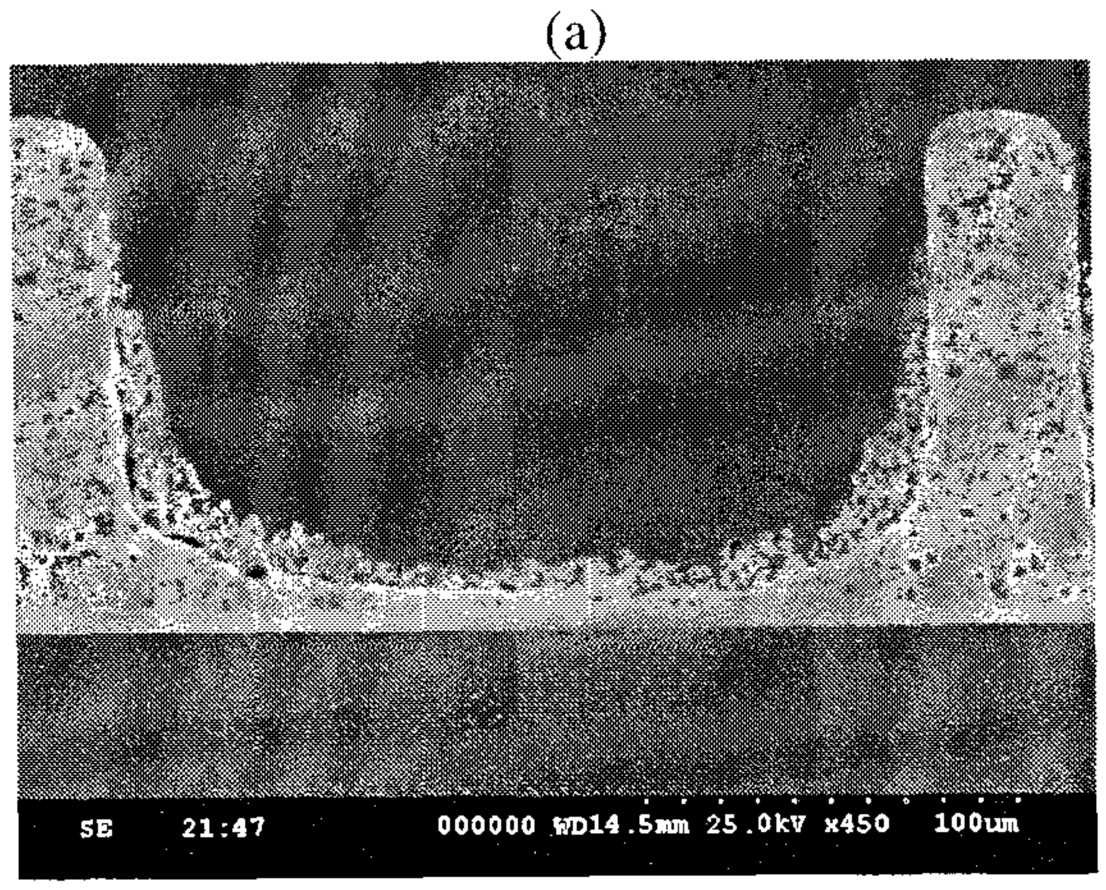
Fig. 2. SEM micrographs of barrier ribs produced by micro-injection molding process.

The appearance of barrier ribs formed by the micro-injection molding process is shown in Fig. 2. As noted in the figure, the side-wall of the barrier ribs is well-defined and smooth.

Cross sections of the barrier ribs with green phosphor coating are shown Fig. 3. Morphologies of the barrier ribs formed were uniform in height and thickness. The thickness of the barrier rib was approximately 40μm and the height was ~130μm. The sub-pitch between the ribs was 250μm. The thickness of the phosphor layer was in a range from 5 to 15μm. These results indicate that the micro-injection molding process is capable of producing barrier ribs of XGA grade of 40 inch panel.



(a)



(b)

Fig. 3. SEM micrographs of barrier ribs with phosphor coating.

3.2. Fabrication of PDP panel

Using the rear plate fabricated, a PDP panel of 2 inch in diagonal was assembled by bonding with a front plate.

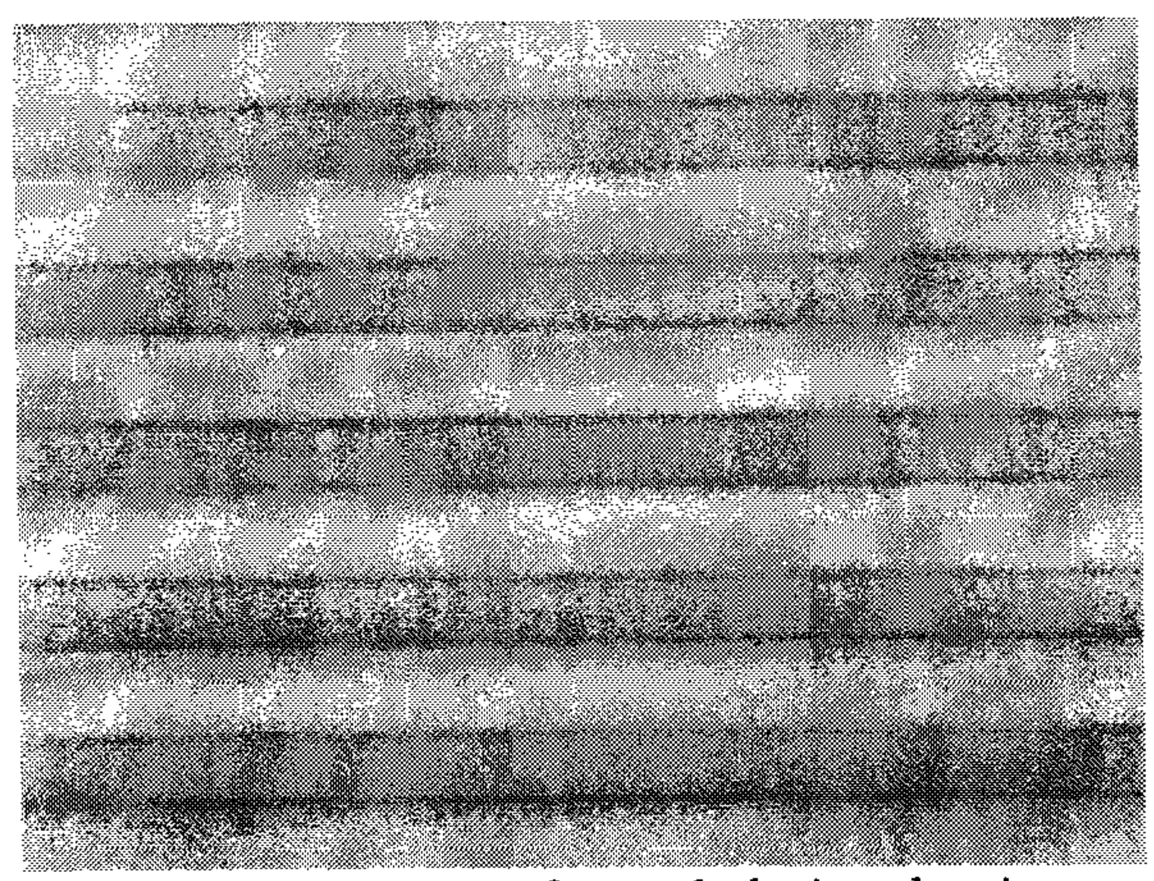


Fig. 4. Appearance of panel during luminance testing.

Figure 4 show the appearance of the panel during luminance measurement testing. The luminance and efficiency of the panel was comparable to conventional PDP panel.

4. Conclusions

Micro-injection molding process was used in the fabrication of barrier ribs of XGA grade PDP. The results demonstrate a possibility of one-step processing of barrier ribs via the micro-injection molding process. The luminance and its efficiency of the panel measured were to be comparable to conventional PDP panel.

4. Acknowledgements

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5. References

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