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고분자 블렌드의 상거동과 수용성 분말사출성형 바인더 개발
The Phase Behavior of Polymer Blends and Water-Soluble Binder System in Powder Injection Molding

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1. Introduction

The binder system in PIM is usually composed of polymer blend which is the mixture of two or more polymer components. Because mechanical properties of PIM are strongly dependent on the properties of binder itself, the phase behavior of polymer blend in the binder should be carefully investigated to ensure processing stability and good final products. In this paper, poly(ethylene-ran-vinyl acetate) (EVA)/Paraffin wax (PW) blend as a binder system was investigated in terms of phase separation and crystallization. The flexural moduli of green parts is related to the degree of crystallization of EVA in the blend and has the maximum value at 35 wt% of EVA. Also, a new binder system consisting of cellulose acetate butyrate (CAB) and poly(ethylene glycol) (PEG) with various molecular weights of PEO was introduced.

2. Experimental

The binders employed in this study were prepared by mixing at 150℃ and mixed with metallic powder. The feedstocks were injection-molded by using a precision injection-molding machine(Technoplas, Japan). The phase and crystallization behavior were observed by optical microscopy (OM), differential scanning calorimetry (DSC), and syncrotron X-ray scattering in Pohang Acceleration laboratory(PAL). Mechanical properties were tested by UTM (Instron 3302).

3. Results

The flexural modulus of the blend became maximum at the 35 wt % EVA, as shown in Figure 1. This behavior can be explained by the fact that this blend composition has the largest relative degree of crystallinity of EVA measured by DSC. We found that the flexural modulus of the binder itself is directly related to that of a feedstock consisting of larger amounts of metal powder and the binder, which can help someone to develop a suitable binder system for a powder injection molding process.

As for a new binder system consisting of CAB and PEG with various molecular weights of PEG, CAB and PEGs exhibited good compatibility. This binder exhibited low enough viscosity to make homogeneous feedstock for the injection molding. Shape maintenance during the extraction by an environmentally favored solvent of water was excellent, and final sintered parts had excellent dimensional stability (± 0.3%) and high sintered density over 98 %, as shown in Figure 2. We also found that injection cycle time was comparable to that of commonly used wax-based feedstock.

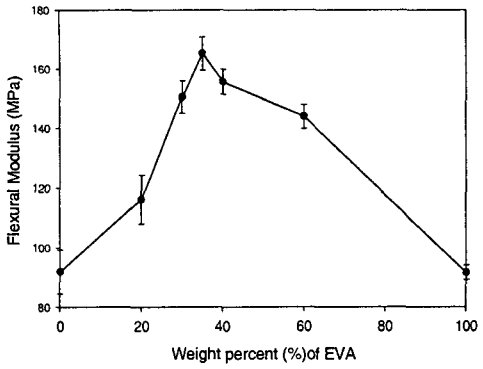

Fig 1. Flexural modulus of various blend composition of EVA/wax blend.

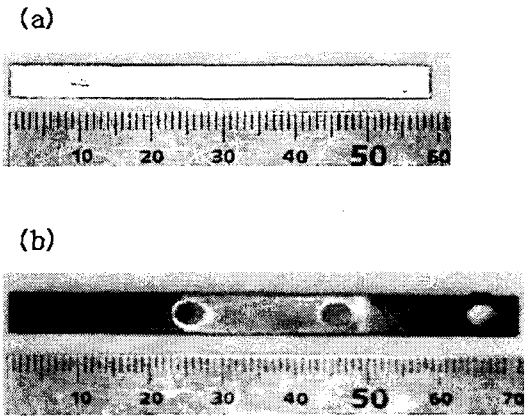

Fig 2. The shapes of (a) the article after sintering (b) green part for CAB/PEG binder system

4. References

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