Restructuration of phase structure and mechanical properties for impact polypropylene copolymer with core-shell dispersed phase

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Abstract In present work, we reported a method to rebuild the complex phase structure of Impact polypropylene copolymer (IPC) with core-shell dispersed particles. By using a co-rotating twin screw extruder, the core-shell particles were produced under appropriate conditions, with the recovery of high toughness. The role of dispersed particle on toughening was analyzed. When the dispersed particle size is smaller than critical value, toughness is mainly contributed by the core-shell particles, while with a particle size larger than critical value, the impact resistance is also affected by rubber size, which is ascribed to the huge interfacial tension during solidification and the great viscosity difference among components.

Phase structure

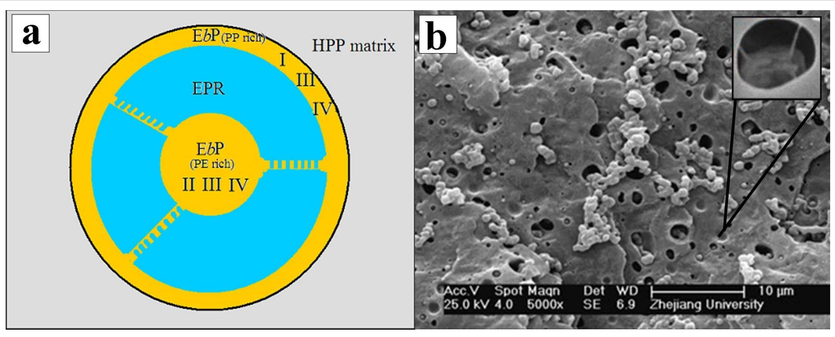

Fig. 1. Phase structure model of IPC and SEM micrograph of dispersed phase.

Morphology evolution

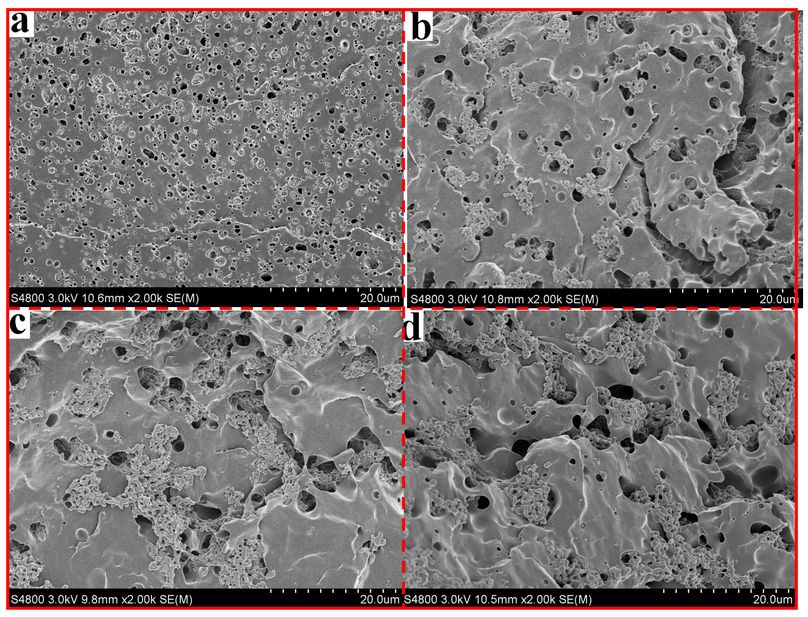

Fig. 2. SEM images of IPC samples annealed at 210 °C for different time. (a) 0 min, (b) 10 min, (c) 20 min, (d) 30 min.

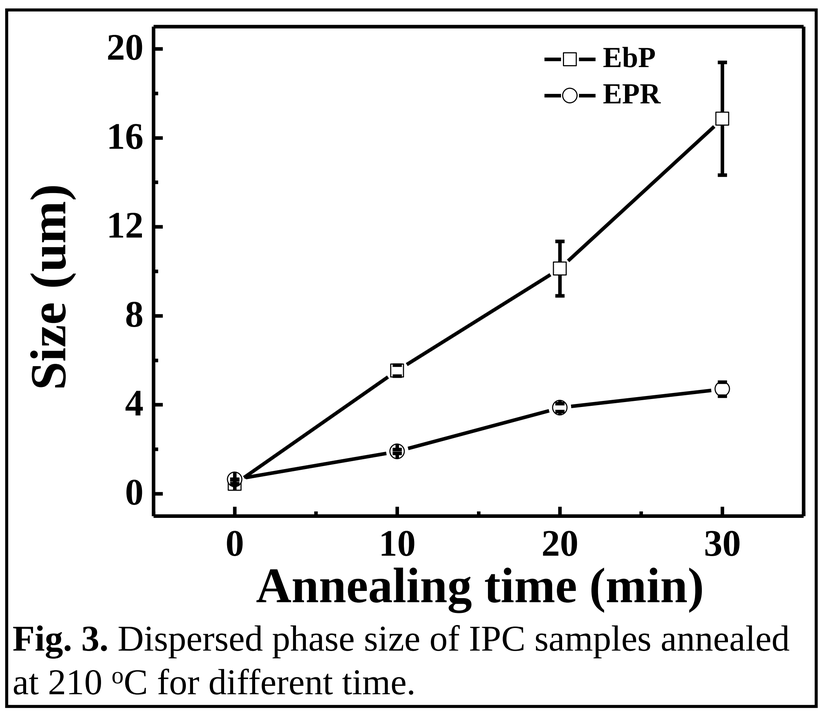

Fig. 3. Dispersed phase size of IPC samples annealed at 210 °C for different time.

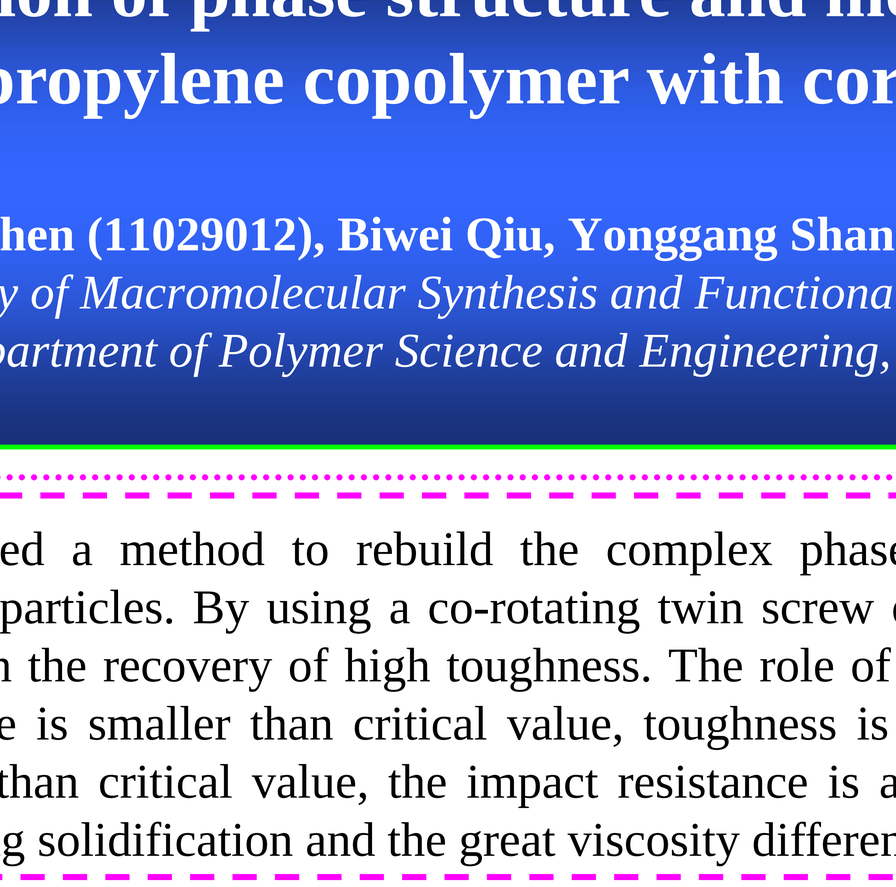

Fig. 4. Notched Charpy impact strength of IPC samples annealed at 210 °C for different time.

Core-shell particle is unstable and could aggregate during melt-state annealing

Restructuration of phase structure

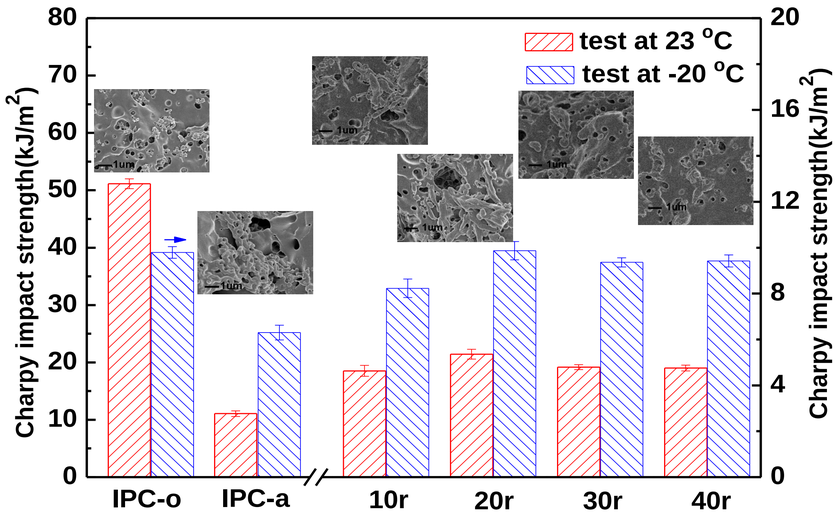

Fig. 5. Notched Charpy impact strength of *IPC-o*, *IPC-a* and samples after extrusion with different rotate speed.

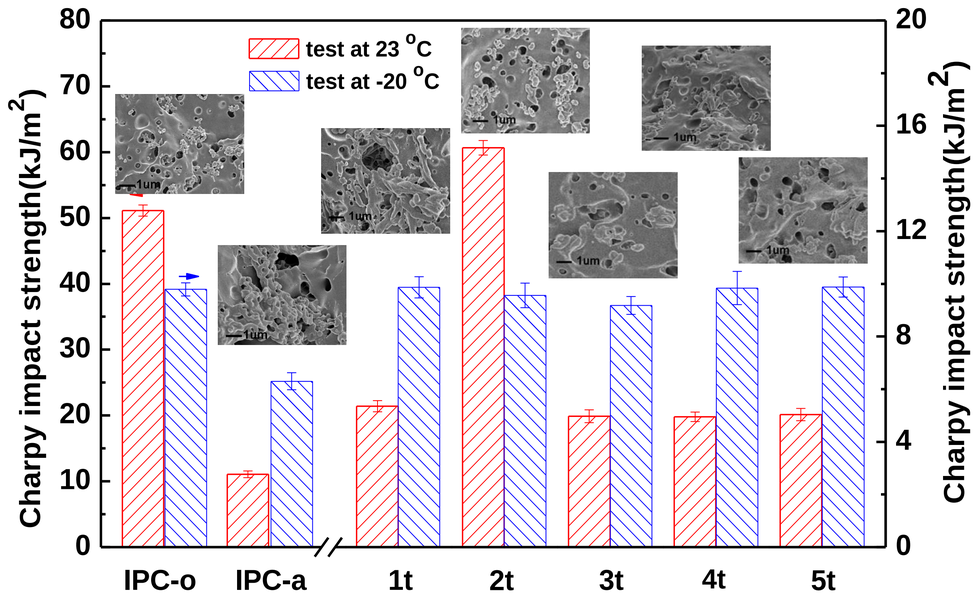

Fig. 6. Notched Charpy impact strength of *IPC-o*, *IPC-a* and samples after multiple extrusion.

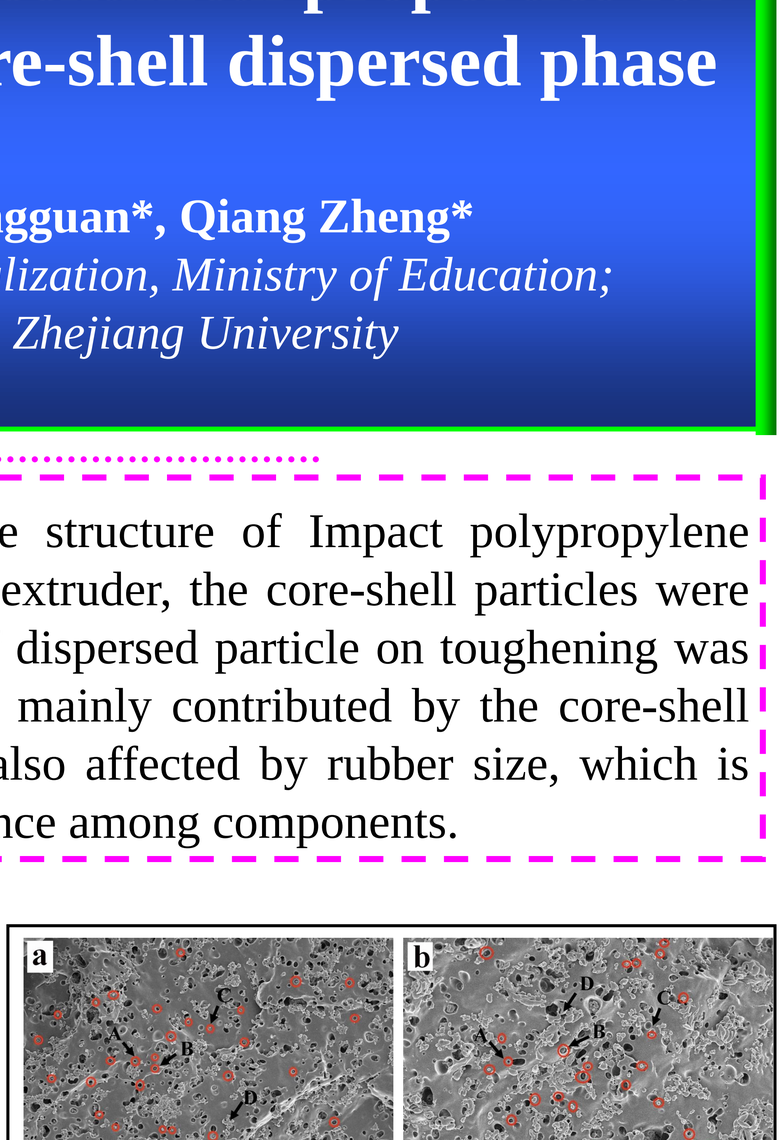

Fig. 7. SEM micrographs of different IPC samples. (a) *IPC-o*, (b) twice-extruded samples

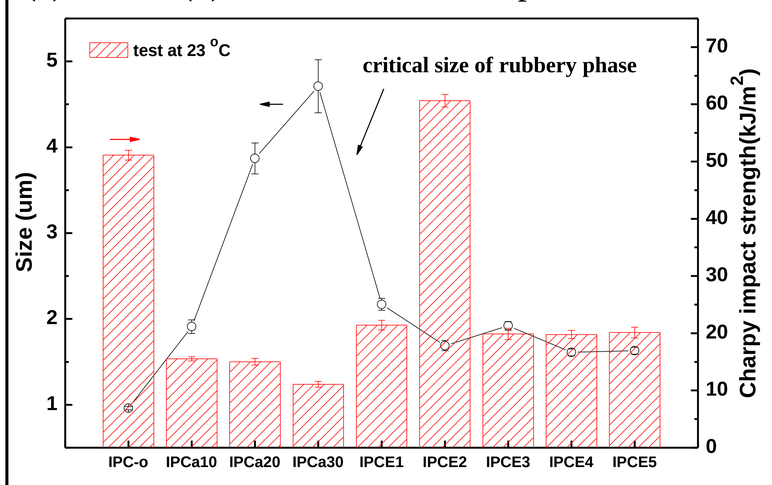

Fig. 8. Rubbery phase size and notched Charpy impact strength of different IPC samples

The phase structure with core-shell dispersed particles in IPC could be reproduced under appropriate conditions, with the recovery of high toughness

Summary

The core-shell structure is unstable and will be destroyed during melt-state annealing, and subsequently results in the degradation of impact performance. The core-shell particle can be rebuilt in appropriate conditions due to the huge interfacial tension during solidification and the great viscosity difference among components with the recovery of excellent impact resistance.

References

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3. Chen RS, Shangguan YG, Zheng Q, et al. Polymer 2011, 52: 2956