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Deformation of high density polyethylene by dynamic equal-channel-angular pressing†

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0.1 Finite element modeling

Finite element methods (FEM) simulations are performed using ABAQUS/Explicit. The dimension of the sample for the first dynamic equal-channel-angular pressing (D-ECAP).process is 40 mm × 12 mm, and the dimensions of the sample for the second D-ECAP process are determined according to the final geometry after the first pass processed (Figure 1 A2). The friction between the sample surface and the die is neglected.

Based on the effective impact energy, the initial pressing velocity is set as 60m/s. The material is isotropic, homogeneous and ideal plastic, and the constitutive equation is given as: $\sigma = E\varepsilon$ for $\varepsilon < \varepsilon_p$, and $\sigma = E\varepsilon_p$ for $\varepsilon > \varepsilon_p$, where σ is the stress, E is the modulus of elasticity, ε is the strain and ε_p is the initial yield strain. $E = 2200Mpa$ and $\varepsilon_p = 0.024$ was used for present work[1].

Figure 1S shows the results of FEM. It is in agreement with the deformation of the grids on the surface of the sample after D-ECAP (Figure 2).

Notes and references

1 E. N. Brown, C. P. Trujillo and G. T. Gray III, AIP Conference Proceedings, 2007, pp. 691–694.

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† Electronic Supplementary Information (ESI) available: FEM, XRD, DSC. See DOI:

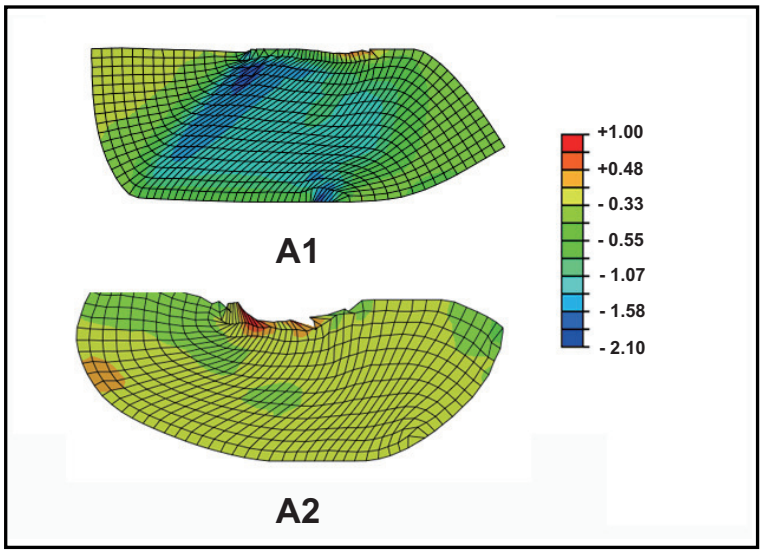

Fig. 1S FEM results of A1 and A2 D-ECAP processes.

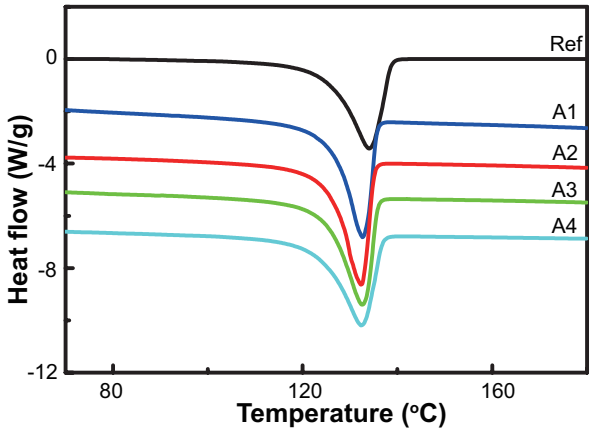

Fig. 2S DSC curves of HDPE samples recovered after different D-ECAP processes.

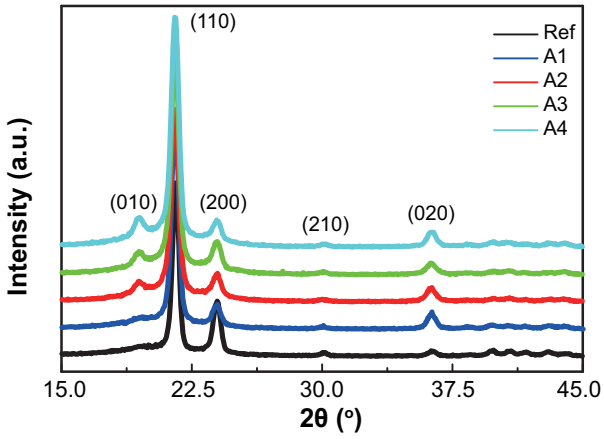

Fig. 3S XRD curves of HDPE samples recovered after different D-ECAP processes.