Electronic Supplementary Information (ESI)

Injection-molded hydroxyapatite/polyethylene bone-analogue biocomposites *via* structure manipulation

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Oscillation shear injection molding (OSIM)

The feature of a melt pattern is quite different from that of conventional injection molding (CIM), and the remarkable difference of two technologies exits in packing stage. During the packing stage of an injection molding cycle, a strong oscillation shear was continuously imposed on the melt, which was given by two pistons moving back and forth at the same frequency with the shear rate ranging from several s^{-1} to hundreds of s^{-1}. The shear flow continued until the mold gates solidified. Hence, the microstructures of the polymer can be well controlled by regulating the processing parameter, especially by tuning the shear rate, which does not exist in CIM methods.

By application of shear flow, the injection molding has been successfully used to suppress the relaxation of molecular chains and fabricate injection-molded parts with rich shish-kebabs [1-3].

Fig. S1 shows the digital picture for injection molding machine, and Fig. S2 shows the local picture for the mold with an oscillation shear supplier. The critical point is its mold, whose 3D schematic illustration is shown in Fig. S3.

Fig. S1 The digital picture for injection molding machine.

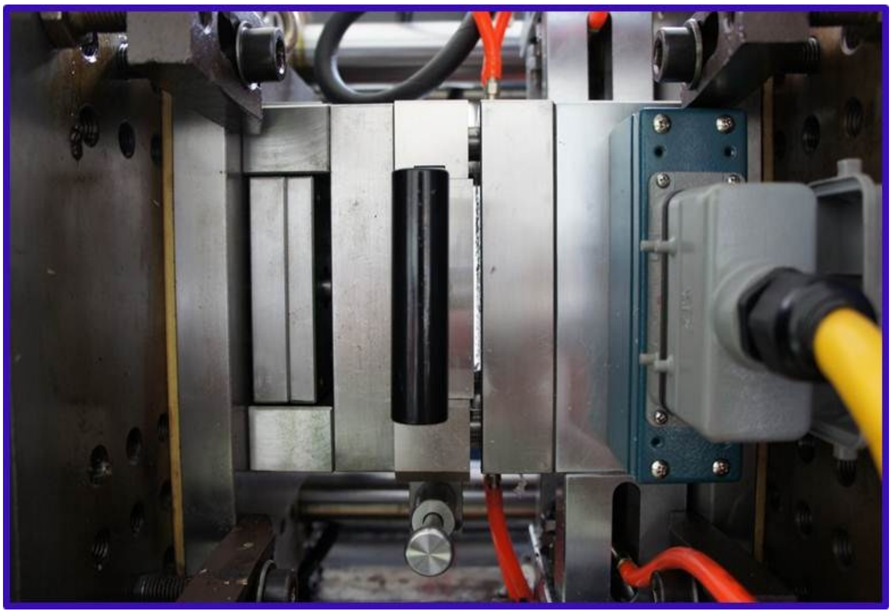


Fig. S2 Local picture for the mold with an oscillatory shear supplier.

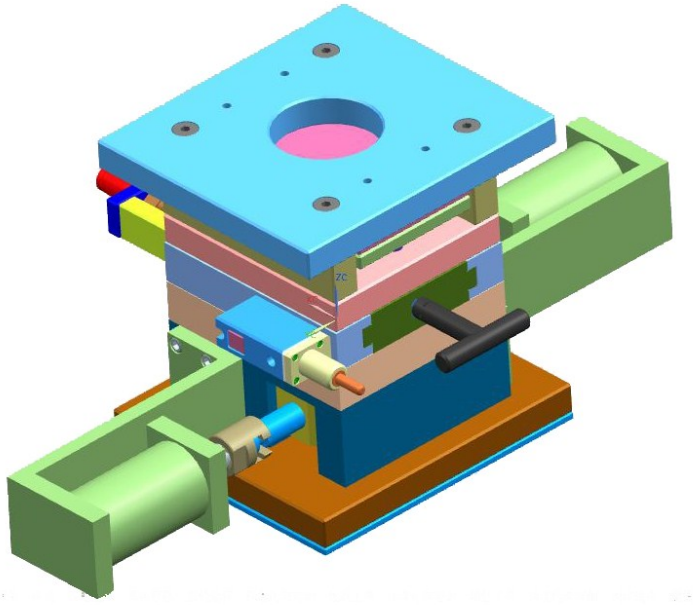


Fig. S3 3D schematic illustration for the mold with an oscillation shear supplier.

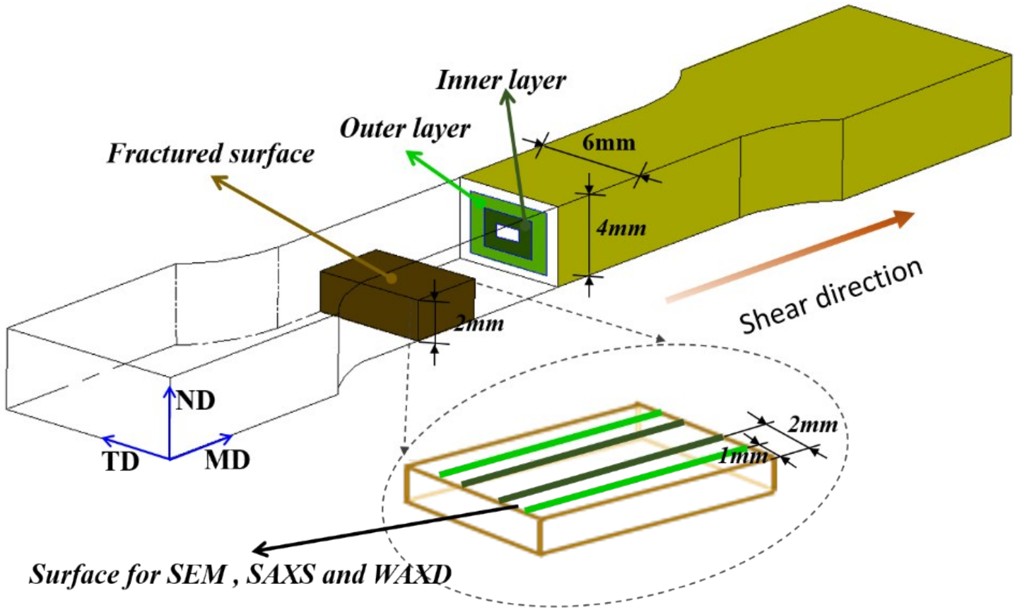


Fig. S4 schematic diagram of the freeze fractured position for SEM observation: MD, the molding direction (i.e., flow direction); TD, the transverse direction; ND, the direction normal to the MD-TD plane.

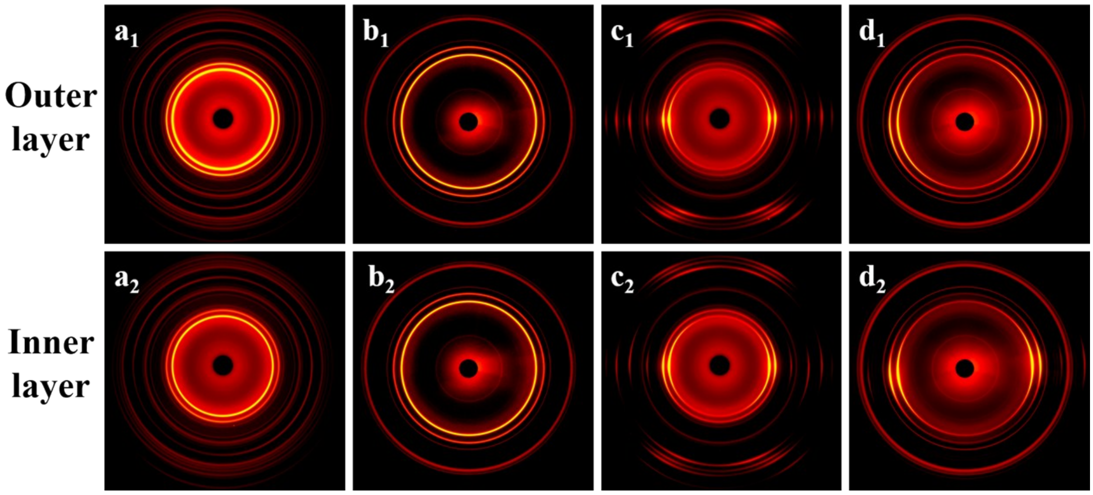


Fig. S5 WAXD patterns of (a) CIM 5 wt% HA/HDPE, (b) CIM 20 wt% HA/HDPE, (c) OSIM 5% HA/HDPE, and (d) OSIM 20 wt% HA/HDPE biocomposites in the outer (a_1, b_1, c_1 and d_1) and inner layers (a_2, b_2, c_2 and d_2). The shear flow direction is vertical.

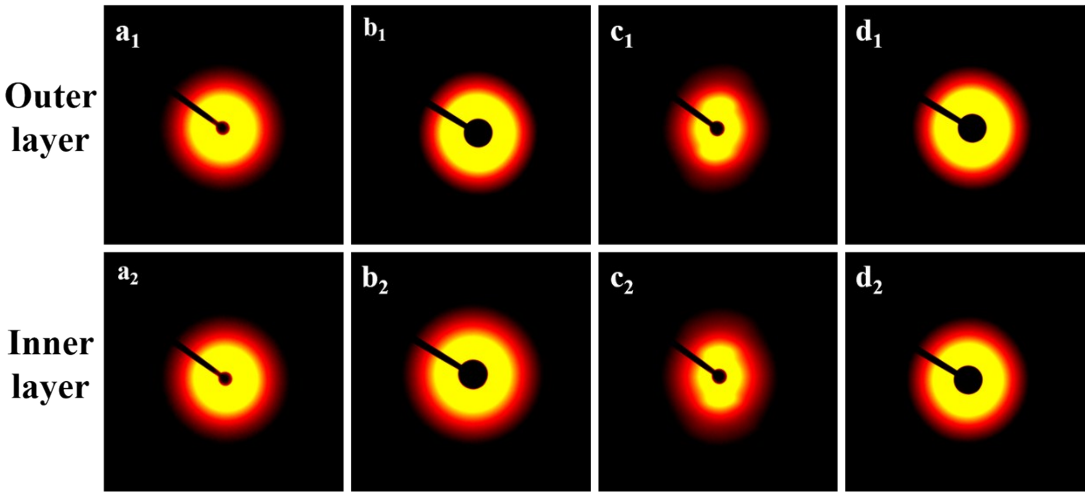


Fig. S6 SAXS patters of (a) CIM 5% HA/HDPE, (b) CIM 20 wt% HA/HDPE, (c) OSIM 5% HA/HDPE, (d) OSIM 20 wt% HA/HDPE biocompostes in the outer (a_1, b_1, c_1 and d_1) and inner layers (a_2, b_2, c_2 and d_2). The shear flow direction is vertical.

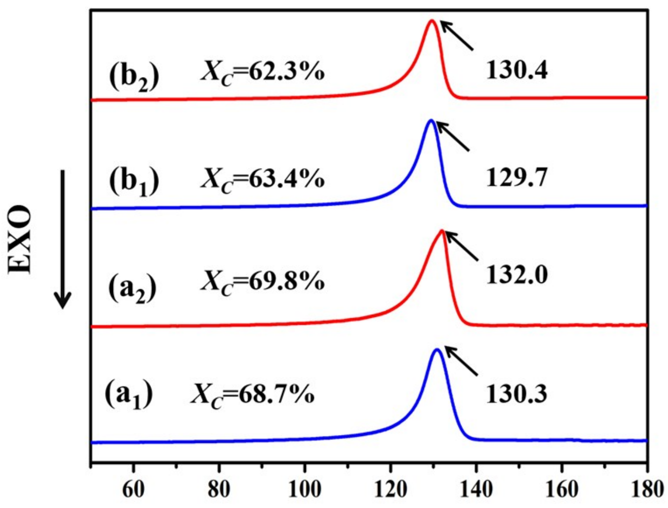


Fig. S7 DSC heating curves of (a) OSIM neat HDPE and (b) CIM neat HDPE from the outer (a_1 and b_1) to inner layer (a_2 and b_2).

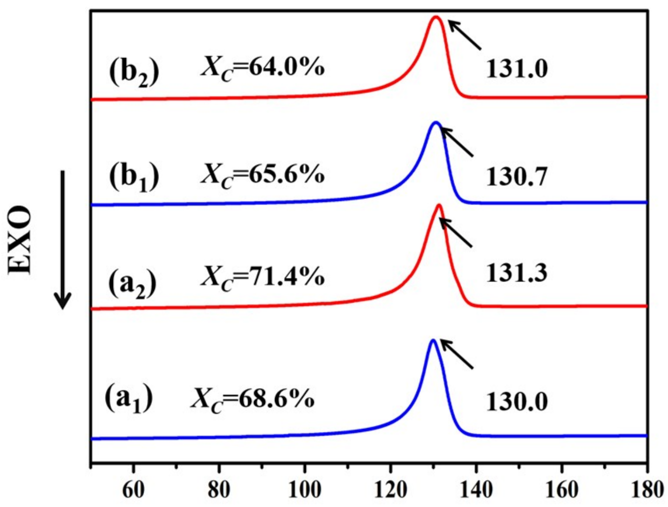


Fig. S8 DSC heating curves of (a) OSIM 5 wt% HA/HDPE and (b) CIM 5 wt% HA/HDPE biocomposites from the outer (a_1 and b_1) to inner layer (a_2 and b_2).

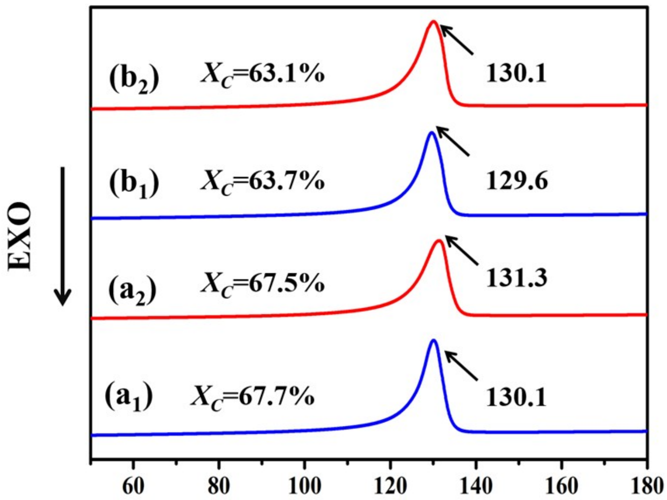
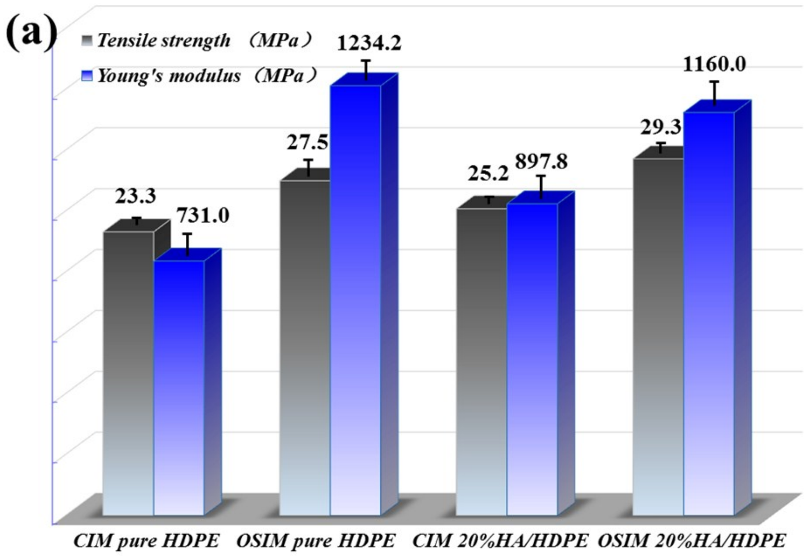


Fig. S9 DSC heating curves of (a) OSIM 20 wt% HA/HDPE and (b) CIM 20 wt% HA/HDPE biocomposites from the outer (a_1 and b_1) to inner layer (a_2 and b_2).



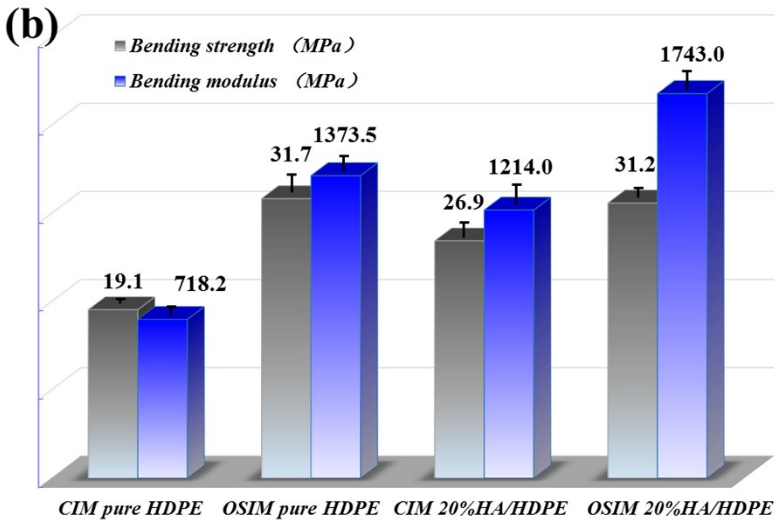


Fig. S10 (a) Tensile and (b) Bending properties of pure HDPE and 20% HA/HDPE biocopmposites fabricated by CIM and OSIM in the transverse direction.

Reference

1. Y. F. Huang, J. Z. Xu, J. Y. Xu, Z. C. Zhang, B. S. Hsiao, L. Xu and Z. M. Li, *Journal of Materials Chemistry B,* 2014, 2, 971-980.
2. H. R. Yang, J. Lei, L. Li, Q. Fu and Z. M. Li, *Macromolecules,* 2012, 45, 6600-6610.
3. L. Xu, C. Chen, G.-J. Zhong, J. Lei, J. Z. Xu, B. S. Hsiao and Z.-M. Li, *ACS Appl. Mater. Interfaces,* 2012, 4, 1521-1529.