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Dramatic Tunability in Melting Temperature and Crystallinity of Polyethylene by Exploiting Confinement During Processing

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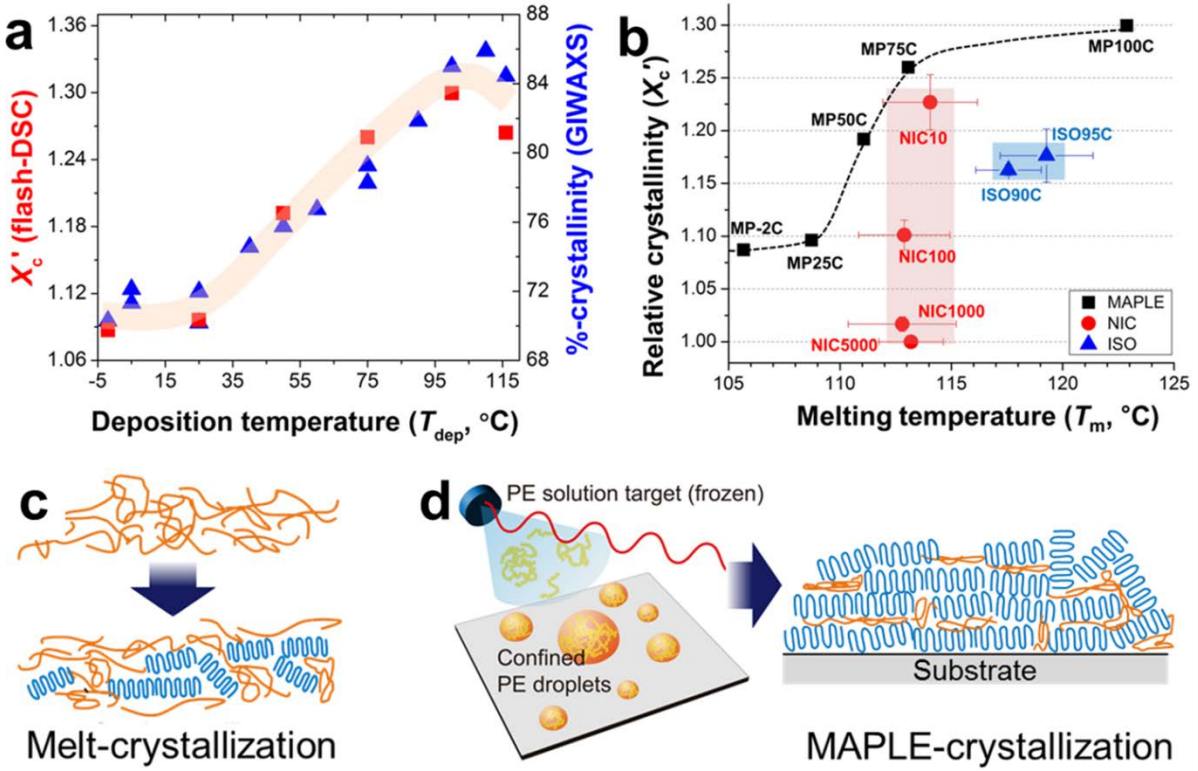
We exploited Matrix Assited Pulsed Laser Evaporation (MAPLE) to deposit polyethylene from a quasi-vapor phase at a controlled substrate temperature, to crystallize polymers under confinement at a wide range of target crystallization temperature, T_c. The team showed the remarkable controllability of the semi-crystalline structure of PE by MAPLE with the control of substrate temp.; see Figure A and B. In comparison to melt-crystallized PE (Fig. C), we discovered that while T_c critically determined the melting temperature, T_m, crystallinity depended not only on T_c but also on how the PE was crystallized. We also demonstrated a greater than 20°C change in T_m of MAPLE processed PE; see Figure B. Our results, indicates that the formation of supramolecular structure of semi-crystalline phase, even with the same metastable crystallites, strongly depends on processing route; see Fig. D.



We expect that this study will provide insight into the design of next-generation industrial polymer processing, where nanoscale control of the structural heterogeneities of semi-crystalline phase is crucial.

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