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聚合物超声压印非成形面熔融缺陷形成机理及抑制

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Mechanism and avoiding of polymer melting on non-forming surface during ultrasonic embossing

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摘要 分析了聚合物超声压印工艺中基片非成形面产生熔融的原因,并提出了相应的抑制方法。基于超声波产热机理指出非成形面熔融现象是由超声工具头-基片界面摩擦引起的,据此提出"摩擦系数差法"来抑制非成形面的熔融现象并通过在聚合物基片非成形面增加表面保护膜(背膜)的手段实现了"摩擦系数差法"。为了对背膜进行优化选择,对比研究了4种背膜条件对聚合物软化时间的影响。提出了超声工具头位移-时间曲线极小值点对应聚合物软化时间的观点,并通过测量超声压印过程中基片-模具界面温度进行了实验验证。实验结果表明,使用Sekisui #622E-50保护膜可缩短聚合物软化时间3.4 s,使用Sekisui #622WB保护膜则可降低软化时间误差0.64 s。实验显示:增加背膜不仅有效地避免了非成形面的熔融现象,同时缩短了超声压印过程中的聚合物软化时间并提高了软化时间重复性。

关键词 : 聚合物, 超声压印, 软化时间, 超声摩擦产热, 非成形面熔融, 表面保护膜

Abstract : This paper analyzes the reason why the polymer is melted on a non-forming surface during ultrasonic embossing and proposes a method to inhibit the polymer melting. On the basis of the heating mechanism of ultrasonic, it points out that the polymer melting phenomenon on non-forming surface is resulted by the friction in a horn-substrate interface. Then, it proposed the method "two interfaces of different friction coefficients" to inhibit the polymer melting and implemented the method by coatings surface protection films on the non-forming surface. To optimize the protection films, and the influences of the four coating film conditions on the softening time are examined through Taguchi method. The results show that the Sekisui #622E-50 film shortens the softening time by 3.4 s and the Sekisui #622WB film reduces the softening time error by 0.64 s. It demonstrates that surface protection films coated can avoid polymer melting on the non-forming surface, and improve the process replication ability and the process stability in ultrasonic embossing.

Key words : polymer ultrasonic embossing softening time ultrasonic friction heating melting on non-forming surface surface protection film

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