

# 采用超支化聚合物降低 PET 的熔体粘度

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**关键词：**超支化聚合物，PET，熔体粘度

近年来，超支化聚合物受到了高分子科学界的广泛重视，这是由于其具有较低的粘度、无链缠绕、有众多的末端基及表面活性等特点，与传统的线型高分子的物理与化学性质有了较大的变化<sup>[1]</sup>，可用作流变改性剂、药物缓释剂、光固涂料以及用于复合材料改性等<sup>[2-4]</sup>。本论文将采用酯交换法合成的新型芳香族超支化聚合物，用于降低 PET 的熔体粘度，从而有效降低 PET 的纺丝温度，减少能耗，减少聚合物的热降解。此外，由于超支化聚合物在纤维表面的存在可使得 PET 纤维表面的物理化学性质发生明显变化，因此可望改善 PET 纤维的染色性。而且通过调节超支化聚合物的末端基为吸湿性基团，亦有望改善 PET 纤维的吸湿性。

本文通过熔融指数研究了芳香族超支化聚合物对 PET 熔体在低剪切情况下流动性能的影响，如 Table1 所示。加入芳香族超支化聚合物后，PET 的熔融流动性大幅改善。纯 PET 在 275°C 下的熔融指数为 20 左右，但仅加入 0.1% 的芳香族超支化聚合物，PET 的熔融指数就增加到 30.22，增加幅度为 50%。而当加入量为 0.5% 时，PET 的熔融指数增加为纯 PET 的 3 倍之多。

Table 1 The melt flowing index of PET with different novel aromatic hyperbranched polymer contents

Content (%)	0	0.1	0.2	0.5
Temperature(°C)				
275	20.03	30.22	36.55	61.05

对添加超支化聚合物的 PET 切片进行了纺丝实验，纺丝工艺条件及纤维的力学性能分别列于 Table2 及 Table3 中。从 Table2 可以看出，加入极少量的超支化聚合物，如 0.05%，PET 的纺丝温度就可以下降 15°C 之多，而且纤维的力学性能变

化不大。

Table 2 The spinning technical parameters of PET with hyperbranched polymer

Conditions \ Content (%)	0	0.05	0.1	0.2
Screw Temp /°C				
I	290	290	290	270
II	305	305	295	285
III	298	285	275	275
IV	295	280	270	270
Gauged pump temp /°C	295	280	275	270
Spinning package temp/°C	310	295	295	290
L/D ratio of spinneret	2.0	2.0	2.0	2.0
Spinneret/mm*f	0.3*36	0.3*36	0.3*36	0.3*36
Spinning speed/m·min <sup>-1</sup>	800	800	800	800

Noted: draw ratio was 3.9.

Table 3 The mechanical properties of PET fiber with different hyperbranched polymer contents

Content (%)	0	0.05	0.1	0.2
Elongation at break (%)	34.47	25.43	32.44	21.64
Tensile strength (CN/dex)	3.81	3.77	3.42	2.95

Table 4 是水与不同 PET 纤维样品的接触角，Figure 1 是水在 PET 纤维表面的照片。从以上测试结果中可以看出，加入超支化聚合物后，由于其比表面积的增加，水在纤维表面的接触角减小，因此纤维的吸湿性将得到一定的改善。

Table 4 The contact angle of PET fiber with water

Content (%)	0	0.05	0.1	0.2
Contact angle	100.07	64.04	60.26	52.1

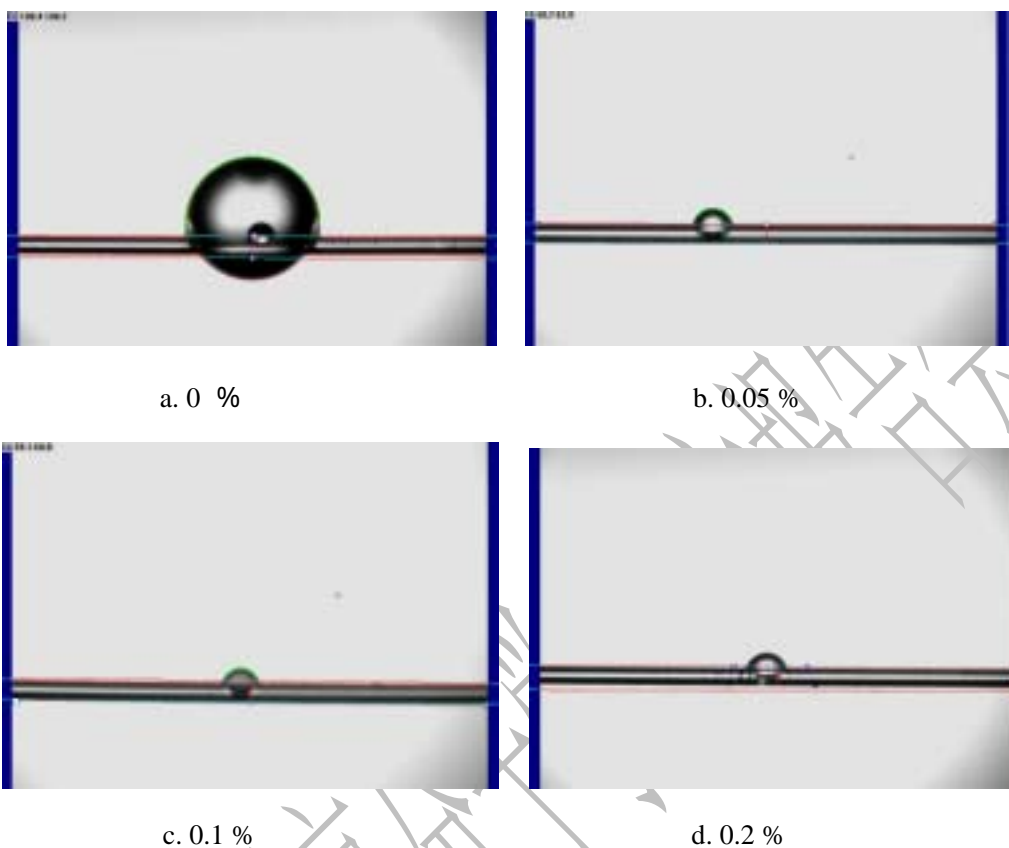


Figure 1 The appearance of water on the surface of PET fiber with different hyperbranched polymer contents

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### **Study on the hyperbranched polymers used to decrease the melting viscosity of PET**

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In this paper, A novel aromatic hyperbranched polymers prepared by ester-exchange were added to PET to decrease the melting viscosity of PET. The melt flowing index of PET and the water contact angle of PET fiber surface with different hyperbranched polymer contents were measured. The results showed that the melt flowing index of PET was decreased significantly owing to the addition of very few hyperbranched polymers. The spinning temperature of PET was decreased by 15 °C as compared with the pure PET when the content of hyperbranched polymers was only 0.05 %. The water contact angle of PET fiber surface decreased as increasing hyperbranched polymer contents, which indicated the PET fiber with hyperbranched polymer was of favorable surface characteristics.

**Keywords:** hyperbranched polymer, PET, melting viscosity