脂肪族支化聚酯酰胺的微生物降解行为研究

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关键词：微生物降解，支化，聚酯酰胺，降解机制

脂肪族聚酯酰胺（PEAs）材料兼具聚酯类的可生物降解性与聚酰胺类良好的力学性能，具有较好的应用潜能[1-4]。无论是在高氧、潮湿的室内环境还是土壤中，PEAs 的粘度随放置时间的延长而下降，表明确实发生了降解。在季戊四醇、丙三醇和酒石酸支化的三类 PEAs 中，酒石酸支化 PEAs 具有最快的生物降解速度。

PEAs 在室内高氧潮湿的环境中，线形 PEA（LPEA）的降解以酰胺链段断裂为主；而对于季戊四醇支化 PEA（PEAp8），酯链段先减少后增加，如 Tab.1 所示。土壤掩埋过程中，LPEA 的降解初期以酯键断裂为主，如 Tab.2 所示，后期开始受到细菌侵袭。对处于两种环境中的 PEAs 薄膜用扫描电镜观察，发现降解一段时间后，材料表面粗糙不平，降解形成裂纹和沟槽，并观察到微生物的富集，如 Fig.1 所示。

主要参考文献

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Tab.1 Ester/amide ratio of PEAs in exposure test by ^{1}H NMR analysis

sample	time (day)	$A_{-C(O)OCH_2-}/A_{-C(O)NHCH_2-}$	$A_{-OC(O)CH_2-}/A_{-NHC(O)CH_2-}$
LPEA	0	0.642	0.671
	60	0.714	0.757
	215	1.005	1.070
PEAp8	0	0.747	0.802
	60	0.718	0.745
	215	0.755	0.814

Tab.2 FT-IR peak area calculations for LPEA in soil burial test

burial time (day)	Band of C=O ester Wavenumber (cm^{-1})	Band of C=O amide Wavenumber (cm^{-1})	A_e^a/A_a^b
0	1737.2	1649.3	0.603
20	1732.5	1639.8	0.528
60	1735.5	1640.1	0.470
120	1733.2	1638.3	0.421
160	1733.3	1641.0	0.319

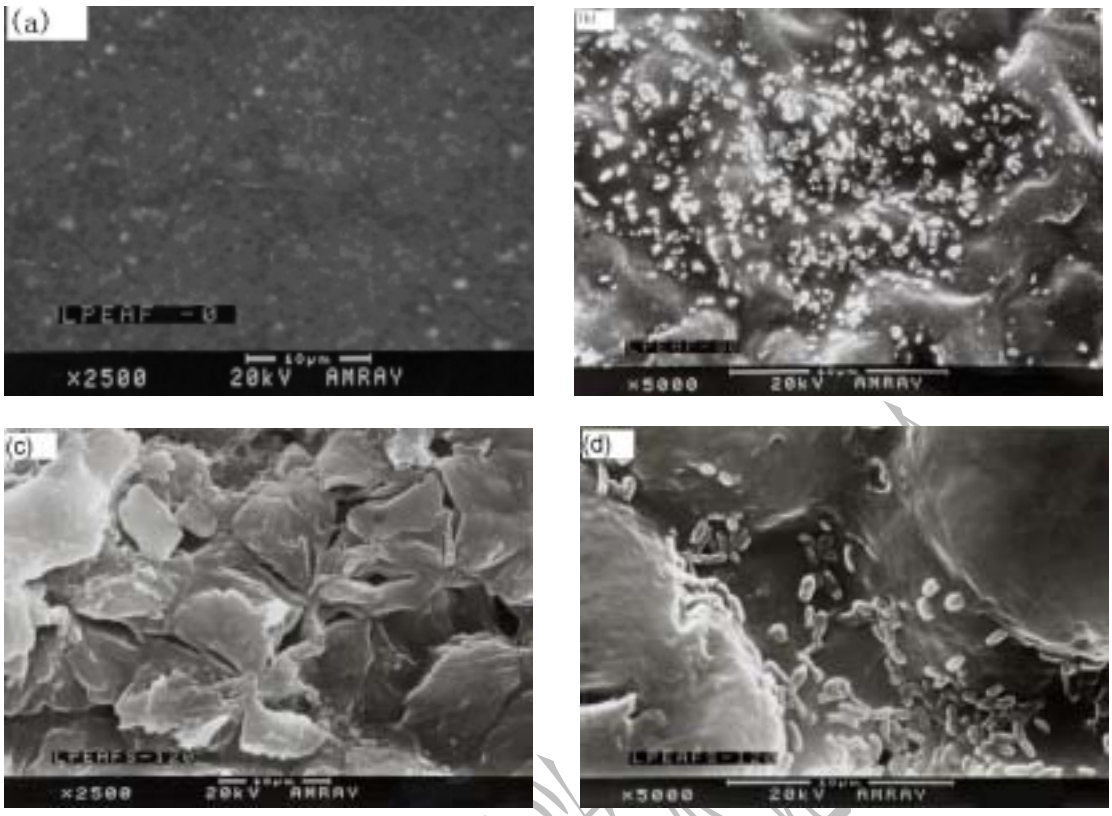

Fig.1 SEM photographs of LPEA film. (a): 0day; (b): at 80days in exposure test; (c) and (d): at 120days in soil burial test.

Biodegradation study of aliphatic branched poly(ester amide)s

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Abstract: Poly(ester amide)s have been interested more recently since they encompassed the degradability of polyesters with the good mechanical and processing properties of polyamides. A preliminary study of PEAs in different natural environments was performed. When PEAs were exposed in environments with high concentration of O_2 and moisture, the biodegradation was involved with the breakage of both amide and ester linkages. In soil burial test, it showed that cleavage of ester linkages was the primary process. Bacillus was also found on the surface of PEAs. Thus aliphatic PEAs were biodegradable. PEAs branched by tartaric acid showed the highest degradation rate in both environments.

Keywords: biodegradation, branching, poly(ester amide)s，degradation mechanism