PA-3 polyamide-3

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polyamide-3, poly(imino-1-oxotrimethylene), poly(β-alanine)	
ACS name	-	poly[imino(1-oxo-1,3-propanediyl)]	
Acronym	-	PA-3	
CAS number	-	24937-14-2	
RTECS number	-	DGo875000	
SYNTHESIS			
Monomer(s) structure	-	CH_2=CHC(O)NH_2	
Monomer(s) CAS number(s)	-	79-06-1	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	71.08	
Method of synthesis	-	hydrogen transfer polymerization of acrylamide in the presence of anionic catalyst; vinyl polymerization is side reaction, which can be prevented if tert-BuOK catalyst is finely dispersed in polymerization solvents	Masamoto, J, Memoirs of Fukui University of Technology, 3, 1, 291, 2003.
Temperature of polymerization	°C	80-200	
Catalyst	-	t-BuONa	
Yield	%	98-99	
Mass average molecular weight, M_w	dalton, g/mol, amu	90,000-140,000	
STRUCTURE			
Crystallinity	%	38	Wolfe, E; Stoll, B, Colloid Polym. Sci,. 258, 300, 1980.
Cell type (lattice)	-	monoclinic (form I); orthorhombic (form II)	
Cell dimensions	nm	a:b:c=0.933:0.478:0.873	Masamoto, J, Memoirs of Fukui University of Technology, 3, 1, 291, 2003.
Unit cell angles	degree	β=60	
Spacing between crystallites	nm	0.378	
Polymorphs	-	I, II	
Chain conformation	-	planar zigzag	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.33 (theoretical=1.39)	
Melting temperature, DSC	°C	330-340 (decomposition)	
Glass transition temperature	°C	111	
Dielectric constant at 100 Hz/1 MHz	-	4.7/	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Elongation	%	10-20	
Flexural modulus	MPa	19,900 (fiber glass-reinforced)	
Young's modulus	GPa	374-414 (theoretical)	Peeters, A; van Alsenoy, C; Bartha, F; Bogar, F; Zhang, M-L; van Doren, V E, Int. J. Quantum Chem. 87, 303-10, 2002.
Water absorption, equilibrium in water at 23°C	%	9 (similar to silk)	

PA-3 polyamide-3

PARAMETER	UNIT	VALUE	REFERENCES
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Halogenated hydrocarbons	-	poor	
Good solvent	-	dichloroacetic acid, formic acid, phenol, sulfuric acid, trifluoroethanol	
Non-solvent	-	chloroform, butanol, methanol, water	
TOXICITY			
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
PROCESSING			
Typical processing methods	-	because polyamide 3 melts with decomposition, melt spinning cannot be used but wet or dry spinning is used; wet spinning is performed from formic acid solution	Masamoto, J, Memoirs of Fukui University of Technology, 3, 1, 291, 2003.
Applications	-	fiber for production of ropes, POM stabilizer (formaldehyde scavenger)	
Outstanding properties	-	thermal stability, fiber strength	
ANALYSIS			
FTIR (wavenumber-assignment)	cm^{-1}/-	C=O – 1640; amide II – 1530; CH_2 – 1420, 1360; amide III – 1283, 1220; amide IV – 1183, 1100, 1040, 960	Morgenstern, U; Berger, W, Makromol. Chem., 193, 2561-69, 1992.
Raman (wavenumber-assignment)	cm^{-1}/-	amide 1 – 1630; N-H – 1227; C-C – 1170	Hendra, P J; Maddams, W F; Royaud, I A M; Willis, H A; Zichy, V, Spectrochim. Acta, 64A, 5, 747-56, 1990.
x-ray diffraction peaks	degree	22.0 and 23.5	