Supporting information:

Thermal properties and radical monitoring after gamma, X-ray, and electron beam irradiation in Polyamide
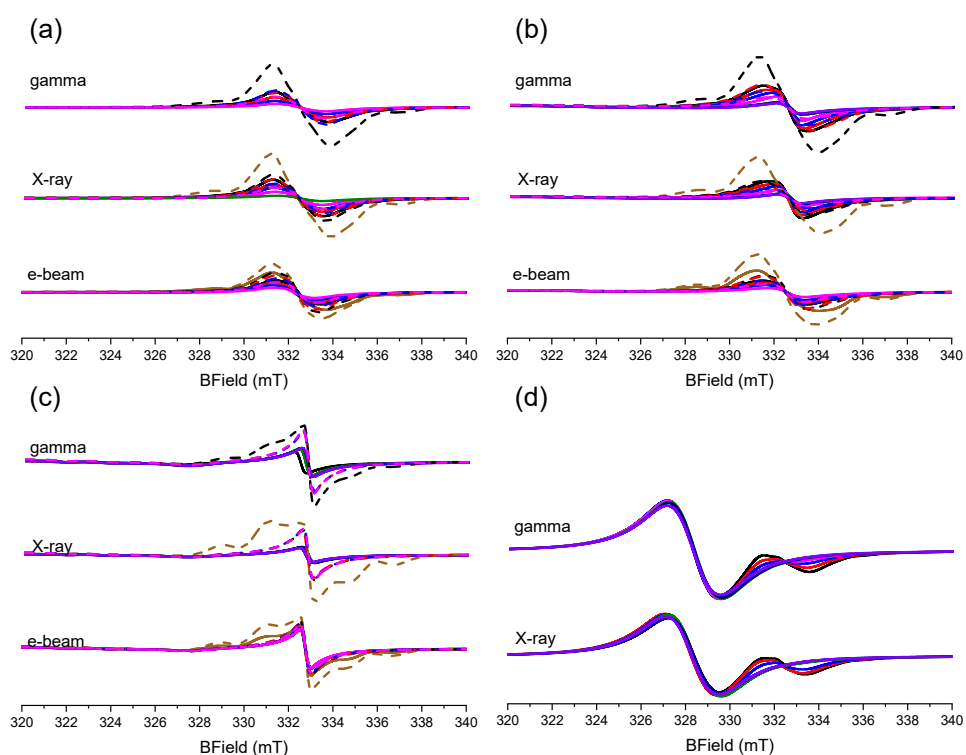
Electron Spin Resonance

Figure S1: ESR signal of irradiated PA samples by gamma, X-ray and e-beam at 50 kGy (solid line) and 100 kGy (dotted line) ESR signal were recorded at one day (brown line) 9 days (black line), 15 days (red line), 30 days (blue line), 60 days (pink line), 120 days (green line), 180 days (navy line) and 380 days (purple line). (a) PA-1. (b) PA-2. (c) PA-3. (d) PA-4.

Model regression results of PA-1

Method

Categorical predictor coding (1; 0)

Regression Equation

Irradiation technologies			
e-beam	Spin/mg	=	154982362322843 - 7417296941425 Ageing after irradiation + 5306709765816 Dose
gamma	Spin/mg	=	143404658668274 - 7417296941425 Ageing after irradiation + 5306709765816 Dose
X-ray	Spin/mg	=	217719144189160 - 7417296941425 Ageing after irradiation + 5306709765816 Dose

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	1,43405E+14	1,00518E+14	1,43	0,168	
Ageing after irradiation	-7,41730E+12	1,28439E+12	-5,77	0,000	1,01
Dose	5,30671E+12	1,04966E+12	5,06	0,000	1,00
Irradiation technologies					
e-beam	1,15777E+13	6,48673E+13	0,18	0,860	1,43
X-ray	7,43145E+13	6,62274E+13	1,12	0,274	1,42

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1,35939E+14	74,57%	69,94%	61,42%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	4	1,19204E+30	2,98009E+29	16,13	0,000
Ageing after irradiation	1	6,16293E+29	6,16293E+29	33,35	0,000
Dose	1	4,72327E+29	4,72327E+29	25,56	0,000
Irradiation technologies	2	2,81628E+28	1,40814E+28	0,76	0,479
Error	22	4,06546E+29	1,84794E+28		
Total	26	1,59858E+30			

Fits and Diagnostics for Unusual Observations

Obs	Spin/mg	Fit	Resid	Std Resid	
5	8,91608E+14	6,07320E+14	2,84288E+14	2,33	R
13	1,11068E+15	7,40973E+14	3,69703E+14	3,02	R

Model regression results of PA-2

Method

Categorical predictor coding	(1; 0)

Regression Equation

Irradiation technologies			
e-beam	Spin/mg	=	246928278495736 - 5708020409260 Ageing after irradiation + 1824114350704 Dose
gamma	Spin/mg	=	347424098552292 - 5708020409260 Ageing after irradiation + 1824114350704 Dose
X-ray	Spin/mg	=	283556043325953 - 5708020409260 Ageing after irradiation + 1824114350704 Dose

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	3,47424E+14	9,38518E+13	3,70	0,001	
Ageing after irradiation	-5,70802E+12	1,19921E+12	-4,76	0,000	1,01
Dose	1,82411E+12	9,80049E+11	1,86	0,076	1,00
Irradiation technologies					
e-beam	-1,00496E+14	6,05655E+13	-1,66	0,111	1,43
X-ray	-6,38681E+13	6,18355E+13	-1,03	0,313	1,42

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1,26924E+14	56,25%	48,29%	34,17%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	4	4,55622E+29	1,13905E+29	7,07	0,001
Ageing after irradiation	1	3,64978E+29	3,64978E+29	22,66	0,000
Dose	1	5,58080E+28	5,58080E+28	3,46	0,076

Irradiation technologies	2	4,47425E+28	2,23713E+28	1,39	0,270
Error	22	3,54413E+29	1,61097E+28		
Total	26	8,10035E+29			

Fits and Diagnostics for Unusual Observations

Obs	Spin/mg	Fit	Resid	Std Resid
5	7,65649E+14	4,78463E+14	2,87186E+14	2,52 R
13	7,25191E+14	4,60259E+14	2,64931E+14	2,32 R
23	6,63203E+14	4,23632E+14	2,39572E+14	2,08 R

R Large residual

Model regression results of PA-3

Method

Categorical predictor coding	(1; 0)

Regression Equation

Irradiation technologies			
e-beam	Spin/mg	=	55944561495113 - 2042747866180 Ageing after irradiation + 5099031780666 Dose
gamma	Spin/mg	=	105905108987982 - 2042747866180 Ageing after irradiation + 5099031780666 Dose
X-ray	Spin/mg	=	41581151504161 - 2042747866180 Ageing after irradiation + 5099031780666 Dose

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	1,05905E+14	1,20464E+14	0,88	0,389	
Ageing after irradiation	-2,04275E+12	1,53926E+12	-1,33	0,198	1,01
Dose	5,09903E+12	1,25795E+12	4,05	0,001	1,00
Irradiation technologies					
e-beam	-4,99605E+13	7,77393E+13	-0,64	0,527	1,43
X-ray	-6,43240E+13	7,93694E+13	-0,81	0,426	1,42

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1,62914E+14	46,44%	36,70%	19,01%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	4	5,06191E+29	1,26548E+29	4,77	0,006
Ageing after irradiation	1	4,67439E+28	4,67439E+28	1,76	0,198
Dose	1	4,36081E+29	4,36081E+29	16,43	0,001
Irradiation technologies	2	1,89681E+28	9,48403E+27	0,36	0,704
Error	22	5,83902E+29	2,65410E+28		
Total	26	1,09009E+30			

Fits and Diagnostics for Unusual Observations

Obs	Spin/mg	Fit	Resid	Std Resid
5	9,86742E+14	5,97424E+14	3,89319E+14	2,66 R
13	8,54593E+14	5,49442E+14	3,05152E+14	2,08 R

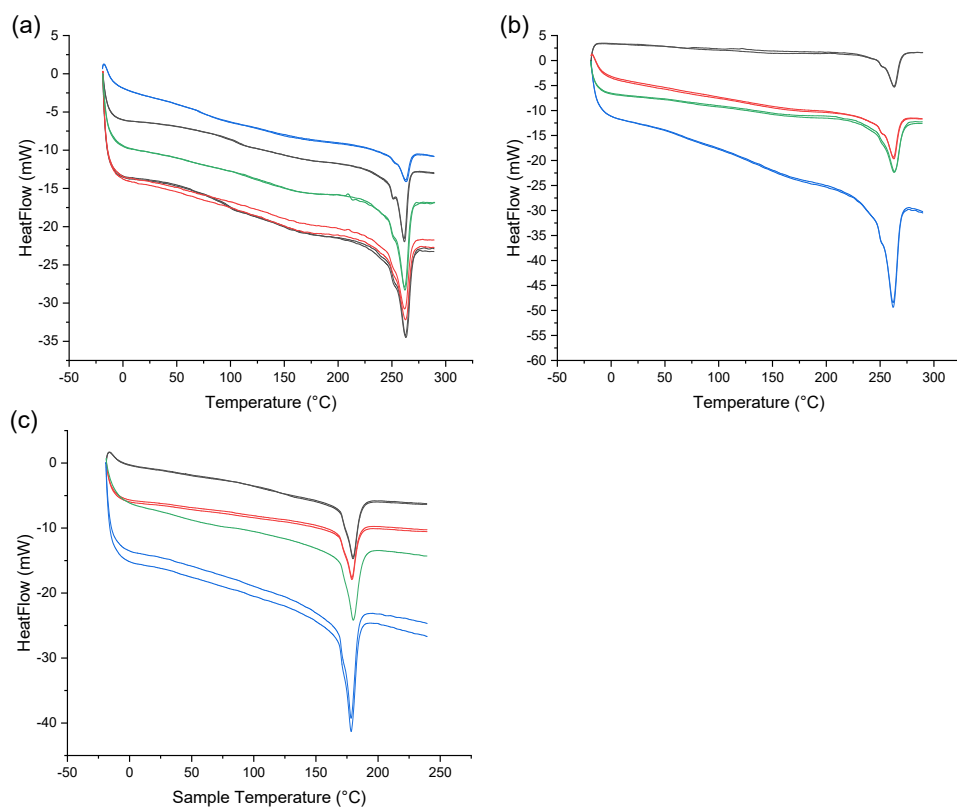R Large residual

Thermal properties (DSC)

Figure S2: Representative DSC responses of PA non-irradiated (black) and irradiated by gamma (red), X-ray (blue) and e-beam (green) at 50 kGy. Data were taken from the second heating ramp. (a) PA-1. (b) PA-2. (c) PA-3.
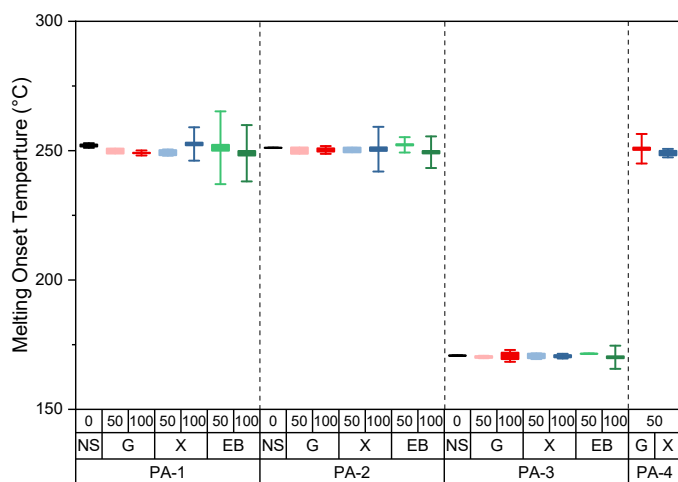

Figure S3: Melting Onset temperature for the PA-1, PA-2, PA-3, and PA-4 non-irradiated (black) and irradiated by gamma (red), X-ray (blue) and e-beam (green) at 50 and 100 kGy. The error bar represents the 95% confidence interval.