Supplementary Materials

Table S1 Details of the ANN models in this work.

Parameters	Network Details
Number of inputs	2 (Temperature, ℃; Heating rate, ℃/min)
Number of hidden layers	1
Number of neurons in the hidden layers	8
Number of outputs	1 (Weight loss, wt.%)
Training function	Levenberg Marquardt (LM)
Activation function	Tansig, Pureline
Performance function	MSE
Data division (%)	70–15–15
Error tolerance	0.001
Validation check	6

Table S2 Common solidstate thermal reaction mechanisms.

Reaction mechanism	Symbol	f(α)	g(α)
1D diffusion	D1	$1/(2\alpha)$	α^2
2D diffusion	D2	$(-\ln(1-\alpha))^{-1}$	$(1-\alpha)\ln(1-\alpha)+\alpha$
First-order reaction	F1	$1-\alpha$	$-\ln(1-\alpha)$
Second-order reaction	F2	$(1-\alpha)^2$	$(1-\alpha)^{-1}-1$
Third-order reaction	F3	$(1-\alpha)^3$	$((1-\alpha)^{-2}-1)/2$
Avrami-Erofeev	A2	$2(1-\alpha)(-\ln(1-\alpha))^{1/2}$	$\left(-\ln(1-\alpha)\right)^{1/2}$
Avrami-Erofeev	A3	$3(1-\alpha)(-\ln(1-\alpha))^{2/3}$	$(-\ln(1-\alpha))^{1/3}$
Avrami-Erofeev	A4	$4(1-\alpha)(-\ln(1-\alpha))^{3/4}$	$(-\ln(1-\alpha))^{1/4}$
Phase boundary-one dimension	R1	1	α
Contracting cylinder	R2	$2(1-\alpha)^{1/2}$	$1-(1-\alpha)^{1/2}$
Power	P3	$3\alpha^{2/3}$	$\alpha^{1/3}$
Power	P4	$4\alpha^{3/4}$	$\alpha^{1/4}$

Table S3 Kinetic parameters of HDPE calculated from FR method.

α	FR-Exp			FR-Pre			Rel. Error	Rel. Error
	Ea (kJ/mol)	log (k_0)	R^2	*Ea* (kJ/mol)	log (k_0)	R^2	*Ea* (%)	log (k_0) (%)
0.1	321.29	20.04	0.99998	267.55	16.28	0.99997	16.726	18.79
0.2	297.07	18.50	0.99991	306.96	19.18	0.99999	3.332	3.69
0.3	281.60	17.51	0.99967	281.60	17.51	0.97626	0	0
0.4	275.94	17.20	0.97626	275.94	17.20	0.99474	0	0
0.5	263.02	16.38	0.99474	263.02	16.38	0.97401	0	0
0.6	284.09	17.87	0.97401	284.09	17.87	0.99991	0	0
0.7	266.29	16.68	0.99991	273.65	17.20	0.96788	2.767	3.11
0.8	297.57	18.89	0.86237	297.57	18.89	0.99229	0	0
0.9	268.64	17.03	0.99229	294.64	18.79	0.99706	9.678	10.38
Average	283.95	19.13	0.99951	282.78	18.53	0.98912	0.410	3.13

Notes: FR-Exp: Activation energy calculated from experimental data by FR method. FR-Pre: Activation energy calculated from ANN predicted data by FR method.

Table S4 Kinetic parameters of HDPE calculated from KAS method.

α	KAS-Exp			KAS-Pre			Rel. Error	Rel. Error
	Ea (kJ/mol)	log (k_0)	R^2	*Ea* (kJ/mol)	log (k_0)	R^2	*Ea* (%)	log (k_0) (%)
0.1	293.05	19.68	0.99989	285.81	19.15	0.99972	2.472	2.69
0.2	291.89	19.70	0.9997	292.08	19.71	0.99963	0.066	0.07
0.3	297.26	20.15	0.99947	297.26	20.15	0.99947	0	0
0.4	288.90	19.62	0.99849	288.90	19.62	0.99849	0	0
0.5	284.67	19.38	0.99651	284.67	19.38	0.99651	0	0
0.6	287.20	19.61	0.99665	287.21	19.61	0.99665	0	0
0.7	287.04	19.65	0.99698	287.53	19.68	0.99807	0.172	0.18
0.8	282.94	19.41	0.99483	282.94	19.41	0.99483	0	0
0.9	284.02	19.56	0.99589	285.99	19.70	0.99427	0.691	0.70
Average	288.55	19.70	0.99760	288.04	19.69	0.99752	0.177	0.07

Notes: KAS-Exp: Activation energy calculated from experimental data by KAS method. KAS-Pre: Activation energy calculated from ANN predicted data by KAS method.

Table S5 Kinetic parameters of HDPE calculated from FWO method.

α	FWO-Exp			FWO-Pre			Rel. Error	Rel. Error
	Ea (kJ/mol)	log (k_0)	R^2	*Ea* (kJ/mol)	log (k_0)	R^2	*Ea* (%)	log (k_0) (%)
0.1	290.30	19.51	0.99990	283.42	19.00	0.99973	2.371	2.600
0.2	289.32	19.55	0.99971	289.50	19.56	0.99965	0.063	0.065
0.3	294.50	19.99	0.99951	294.49	19.99	0.99951	0	0
0.4	286.60	19.49	0.99861	286.60	19.49	0.99861	0	0
0.5	282.62	19.26	0.99678	282.62	19.26	0.99678	0	0
0.6	285.08	19.49	0.99691	285.08	19.49	0.99691	0	0
0.7	284.96	19.53	0.99721	285.43	19.56	0.99822	0.164	0.173
0.8	281.10	19.31	0.99524	281.10	19.31	0.99524	0	0
0.9	282.19	19.46	0.99622	284.05	19.59	0.99473	0.660	0.677
Average	286.30	19.56	0.99779	285.81	19.55	0.99771	0.170	0.058

Notes: FWO-Exp: Activation energy calculated from experimental data by FWO method. FWO-Pre: Activation energy calculated from ANN predicted data by FWO method.

Table S6 Kinetic parameters of HDPE calculated from CR method.

β	CR-Exp			CR-Pre			Rel. Error	Rel. Error
	Ea (kJ/mol)	log (k_0)	R^2	*Ea* (kJ/mol)	log (k_0)	R^2	*Ea* (%)	log (k_0) (%)
10	490.03	33.88	0.99876	491.71	34.00	0.99876	0.342	0.348
20	474.15	32.56	0.99911	478.01	32.83	0.99946	0.814	0.825
30	482.91	33.08	0.99906	484.57	33.19	0.99936	0.342	0.340
Average	482.36	33.49	0.99898	484.76	33.61	0.99919	0.497	0.371

Notes: CR-Exp: Activation energy calculated from experimental data by CR method. CR-Pre: Activation energy calculated from ANN predicted data by CR method.

Table S7 The MSE and R^2 of five groups.

group	MSE	R^2
1	1.8166×10^{-2}	0.99992
2	1.7564×10^{-2}	0.99993
3	1.7993×10^{-2}	0.99992
4	1.8051×10^{-2}	0.99991
5	1.7982×10^{-2}	0.99992

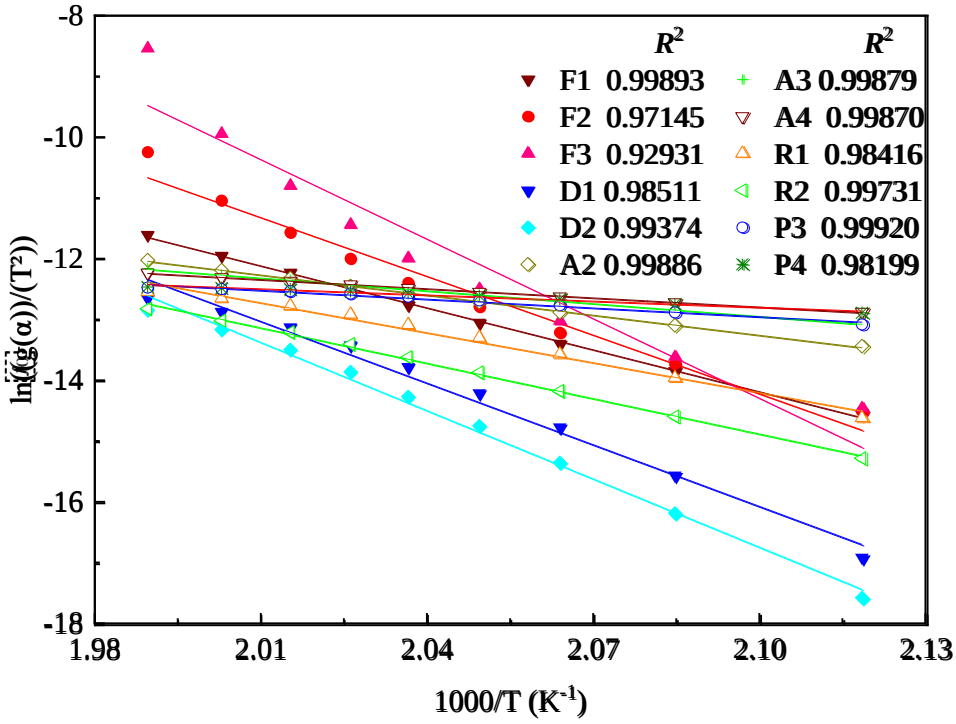

Fig. S1 The calculation results of 12 Mechanism functions at β=20℃/min.

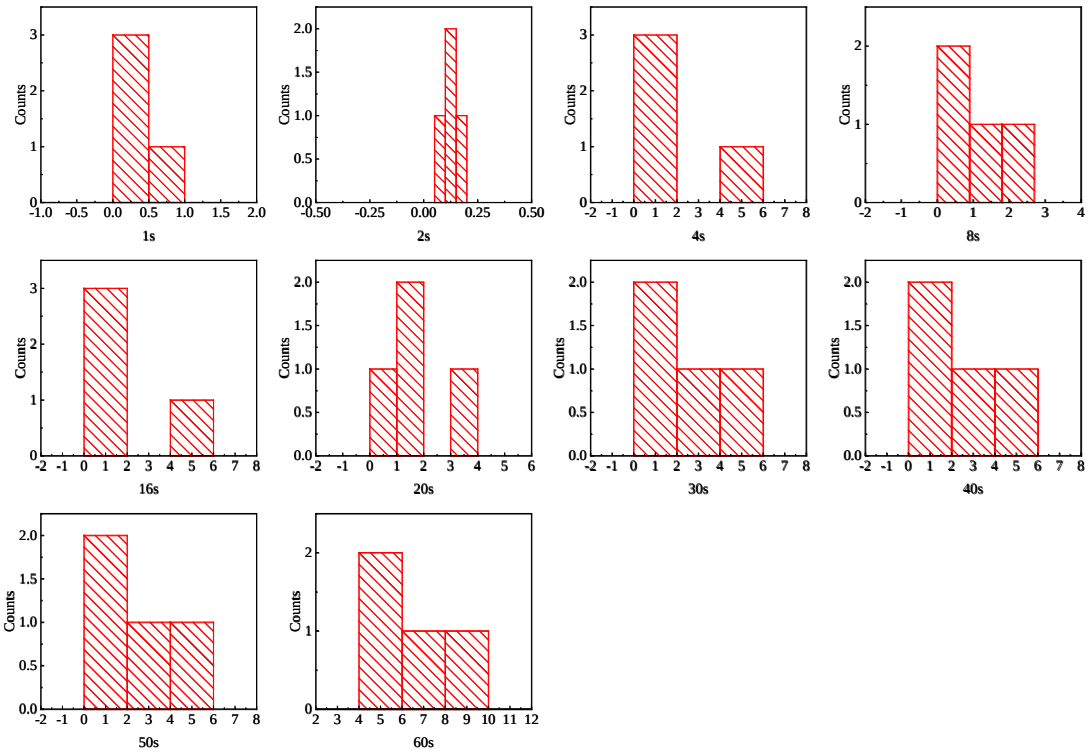

Fig. S2 Frequency distribution histogram of relative error (*Ea*) for different temporal resolution.