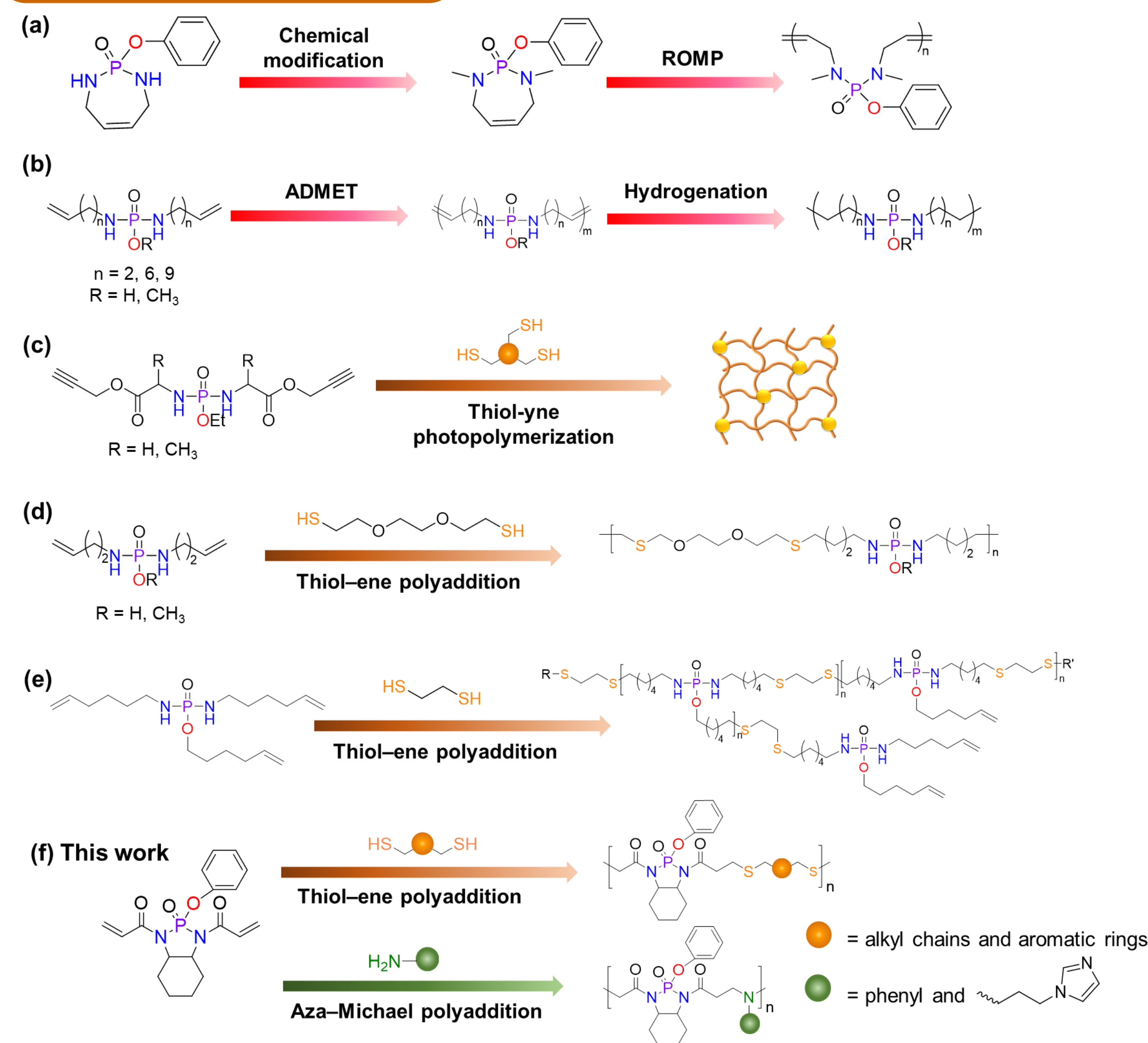


New Class of Polyphosphorodiamidates for Sustainable Applications

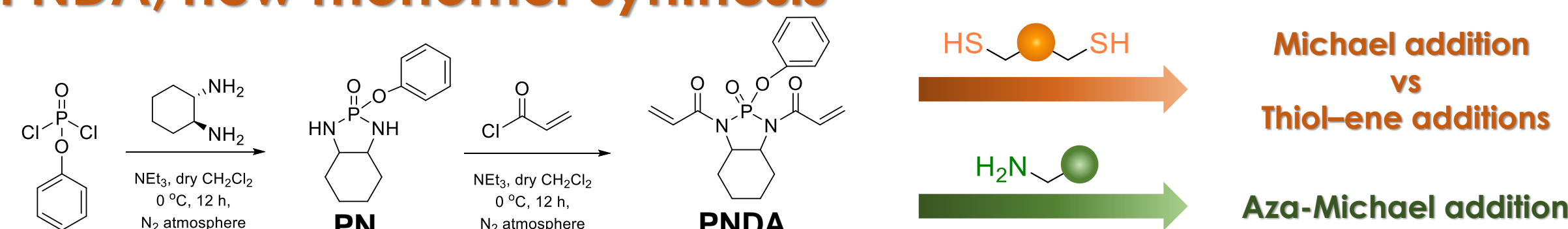
1 Challenge

Herein, we present the synthesis a phosphorus-containing content diacrylate monomer. The monomer was subsequently reacted with various amine and thiol compounds via thiol-ene and aza-Michael polyaddition to obtain a new class of polyphosphorodiamidates.

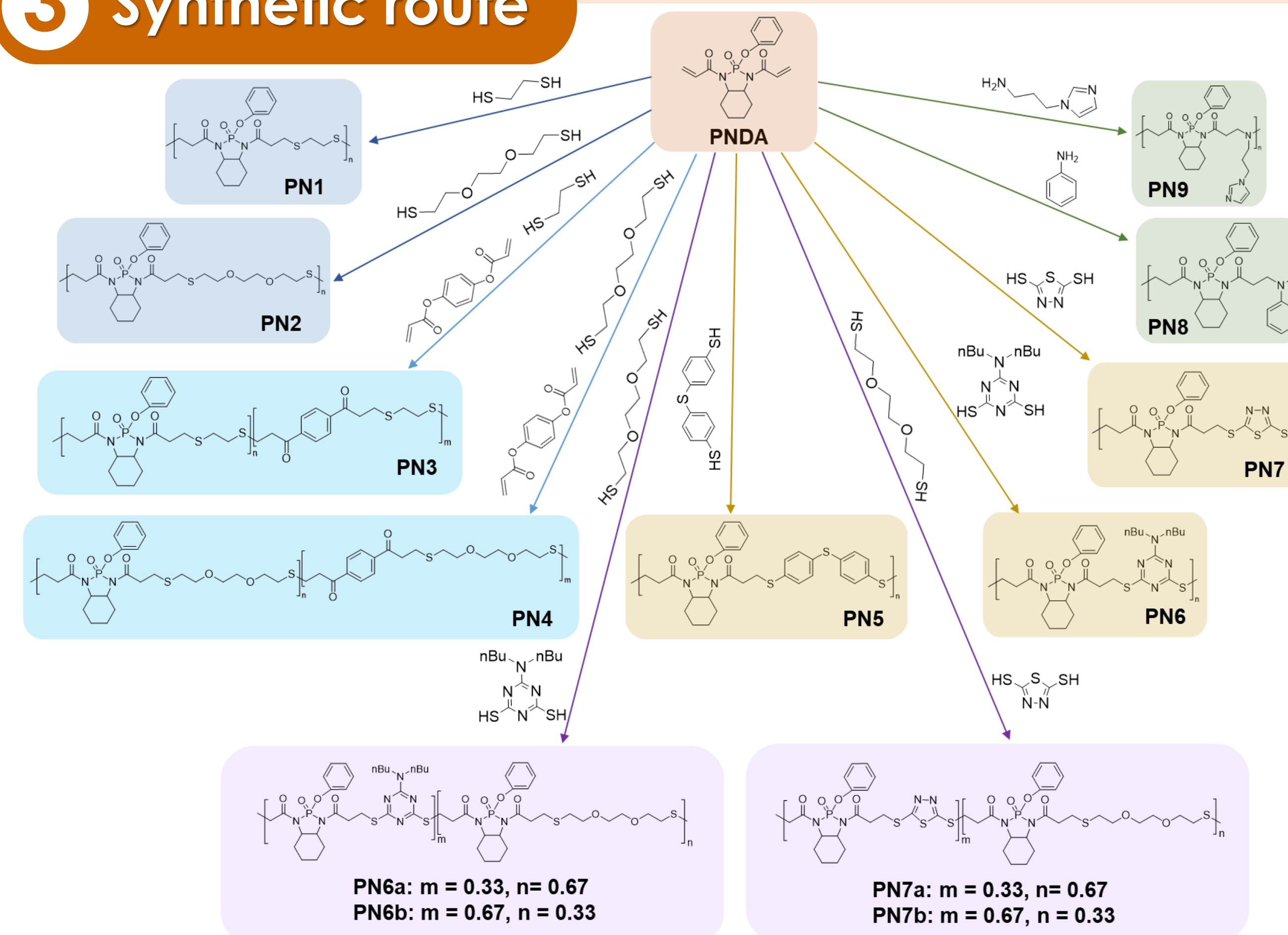
2 Concept



PNDA, new monomer synthesis



3 Synthetic route

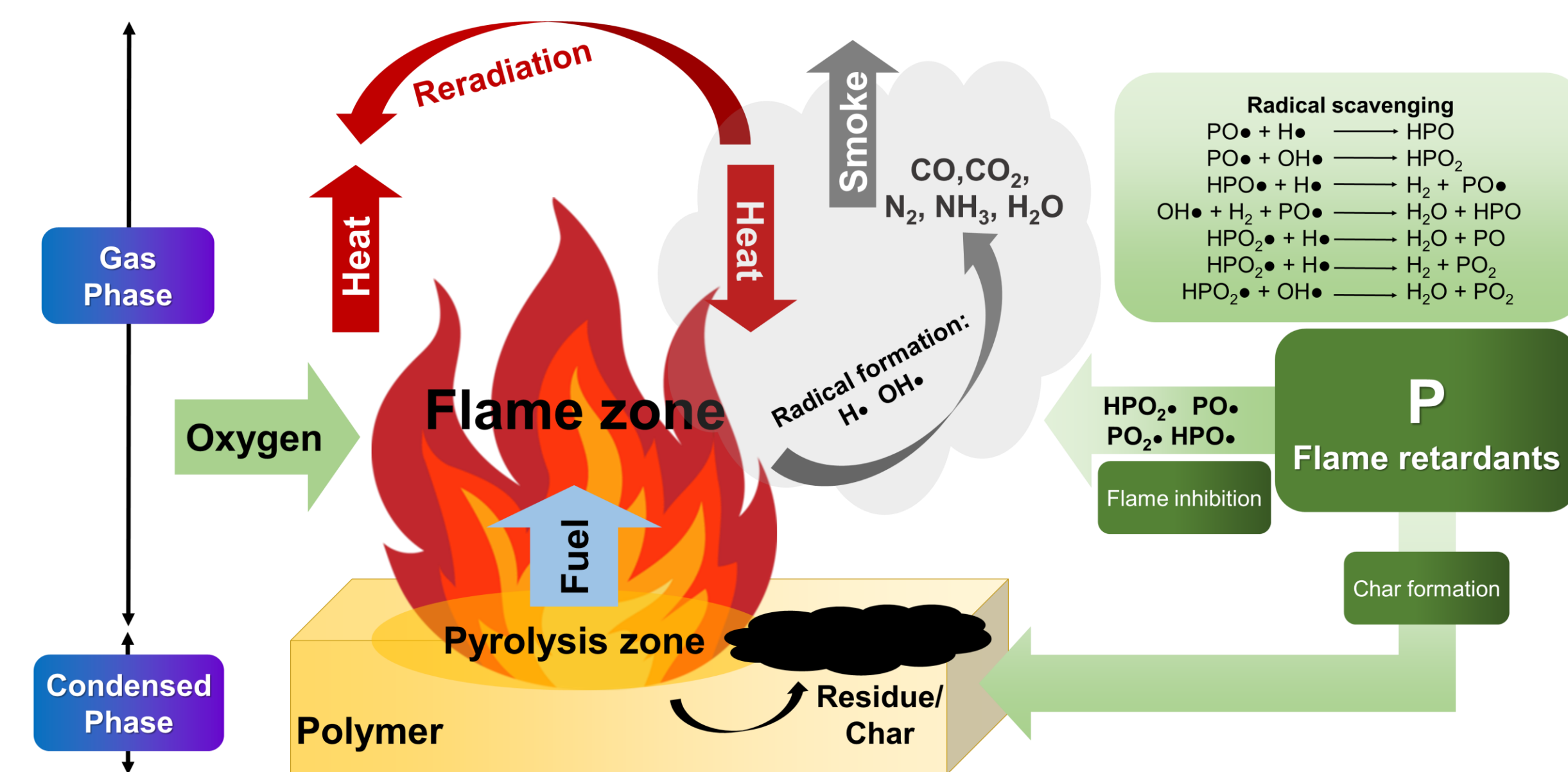
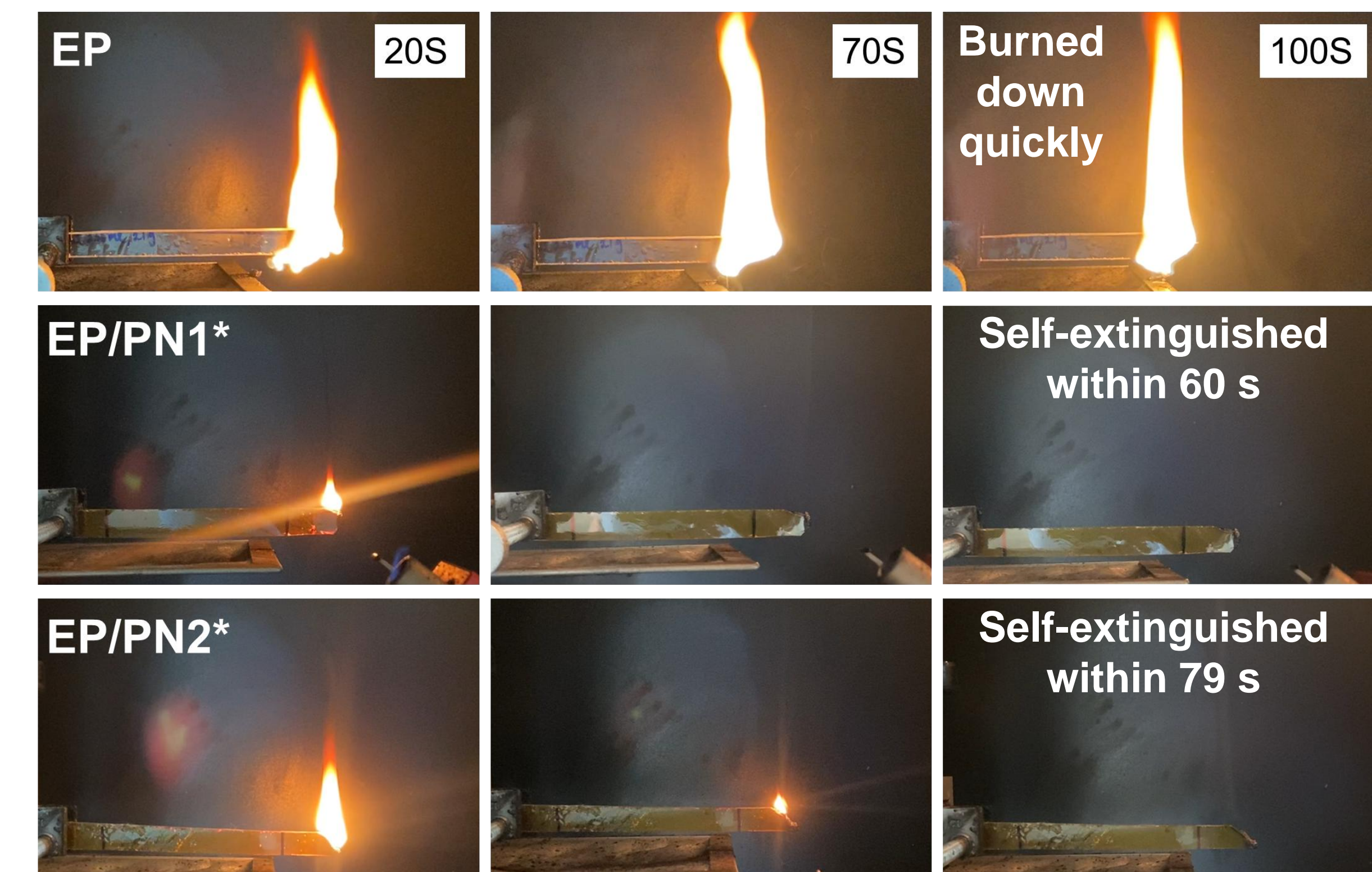
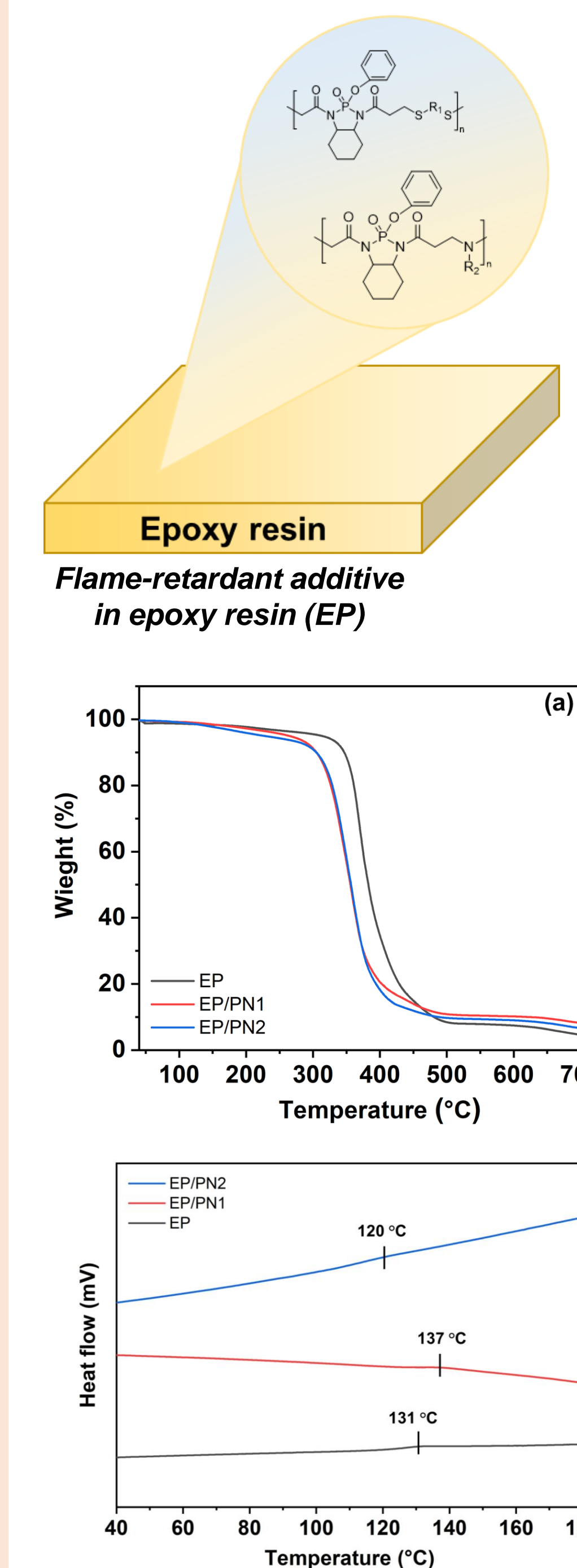


Michael, Aza-Michael, and Thiol-ene Additions

Molecular weight (M_w) and T_g prepared by Michael addition (PN1–PN7), aza-Michael addition (PN8–PN9), and radical thiol-ene polyaddition (PN1*–PN7*).

Michael	D ($m^2 \cdot s^{-1}$)	M_w ($g \cdot mol^{-1}$)	Radical	D ($m^2 \cdot s^{-1}$)	M_w ($g \cdot mol^{-1}$)	T_g ($^{\circ}C$)
PN1	3.32×10^{-11}	35,750	PN1*	1.03×10^{-10}	8,750	–9
PN2	5.70×10^{-11}	8,750	PN2*	1.25×10^{-10}	5,250	–17
PN3	6.62×10^{-11}	5,950	PN3*	9.20×10^{-11}	11,600	104
PN4	6.64×10^{-11}	5,900	PN4*	1.11×10^{-10}	7,100	103
PN5	9.57×10^{-11}	2,300	PN5*	cross-linked		57
PN6	7.06×10^{-11}	5,000	PN6*	3.11×10^{-10}	500	65
			PN6a*	1.39×10^{-10}	3,950	–8
			PN6b*	2.19×10^{-10}	1,200	–5
PN7	7.57×10^{-11}	4,200	PN7*	3.37×10^{-10}	400	95
			PN7a*	8.51×10^{-11}	14,300	13
			PN7b*	9.77×10^{-11}	9,950	8
PN8	1.26×10^{-10}	5,100				34
PN9	8.73×10^{-11}	13,400				79

Thermal and Flammability Test



Higher P content

Higher thermal stability

Increase T_g

Better Flame-retardant



4 Conclusions

Phosphorus-containing polymers with improved thermal stability and flame-retardant were synthesized