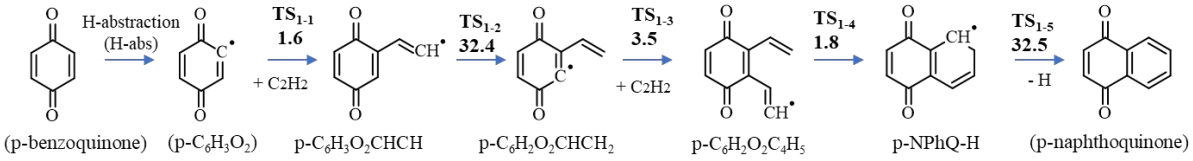

TS	Reaction	k = A Tn exp(-Ea/RT)		
		A	n	Ea
H-abs	p-benzoquinone + H → p-C6H3O2 + H_2	1.01×10^{8}	2.06	13156
	p-benzoquinone + CH_3 → p-C6H3O2 + CH_4	3.76×10^{1}	3.44	10314
	p-benzoquinone e + O → p-C6H3O2 + OH	3.56×10^{5}	2.74	9384
	p-benzoquinone + OH → p-C6H3O2 + H_2O	4.73×10^{1}	3.47	-2005
TS1-1	p-C6H3O2+C2H2 → p-C6H3O2CHCH	7.15×10^{4}	2.31	1590
TS_{1-2}	p-C6H3O2CHCH → p-C6H2O2CHCH2	4.24×10^{3}	2.51	26260
TS_{1-3}	p-C6H2O2CHCH2+C2H2 → p-C6H2O2C4H5	2.11×10^{4}	2.31	3050
TS_{1-4}	p-C6H2O2C4H5 → p-NPhQ-H	3.94×10^{11}	0.06	1050
TS_{1-5}	p-NPhQ-H → p-naphthoquinone +H	1.75×10^{11}	0.88	33140

Figure S3. Top panel: PES of the growth from p-benzoquinone to p-naphthoquinone via C_2H_2 addition. Barrier heights (in kcal/mol) at 0K calculated at the CBS-Q/CAM-B3LYP/6-311+G(2d,p) level of theory, including ZPE. **Bottom panel:** The corresponding rate constants (k) for a temperatures range of 500 to 2000 K computed at CBS-Q/CAM-B3LYP/6-311+G(2d,p) level of theory. Units are in cm, mol, s and cal.