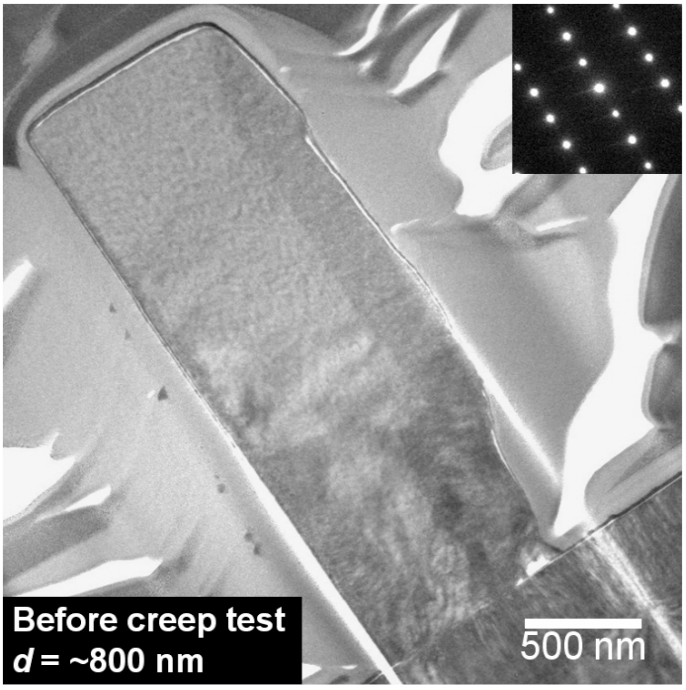
Supplementary material

(a)



(b)

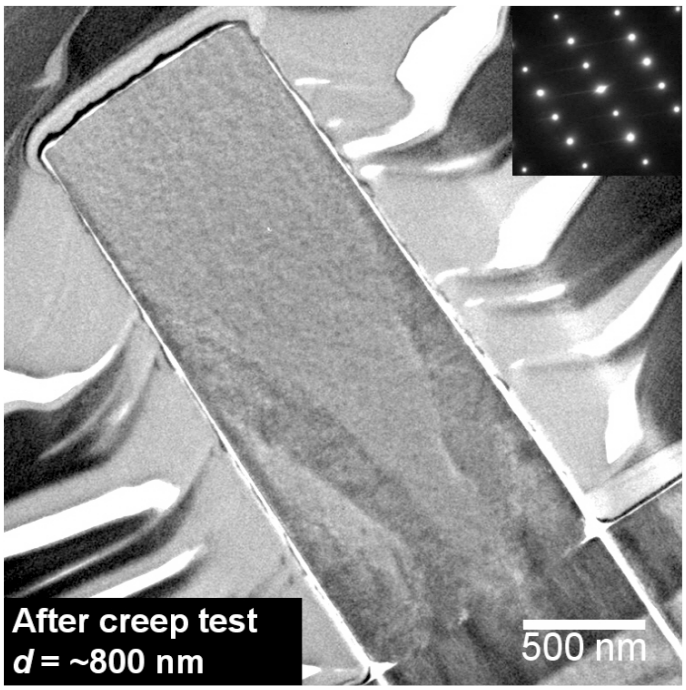


Figure S1. Representative bright field TEM images of ZnO nanorods (a) before and (b) after creep tests. Insets are diffraction pattern of nanorods indicating [1 1 -2 0] zone.

Table S1. Mechanical properties of ZnO nanowire (NW), nanobelts (NB), nanorods (NR), nanopillar (NP), nanotube (NT), forest(F) examined with various nanomechanical testing methods (d: diameter, t: thickness, w: width, E: elastic modulus, E_r: reduced modulus, H: hardness, σ_f: fracture strength, ε_f: fracture strain, σ_y: yield strength, σ_b: buckling strength).

Method	Shape	Size [nm]	E or E_r [GPa]	H [GPa] or σ [GPa] or ε	Marks	Ref
Indentation	NW	(d) 20-50	-	(H) 3.4	Double contact model	[S1]
	NW	(d) 50-300	(E_r) 58.7	(H) 3.3	Observation of creep	[S2]
	NW, NB	(d) 25.5-134.4, (t) 250, (w) 450	(E) 104-198	-	d↓⇒E↑	[S3]
	NB	(w) ~100 (t) ~10-100	(E_r) 20-50	(H) 2-8	Indentation size effect	[S4]
	NB	(w) 270-700 (t) 50-140	(E) 31.1	-	Observation of creep	[S5]
	NR	(d) 300-1000	(E) 63, 116	(H) 9.72, 7.79	(0 0 0 1), (0 1 -1 0) plane	[S6]
	MW	(d) 5000-10000	(E) 31.68	(H) 5.82	Observation of creep	[S7]
Bending test	NW	(d) 45	(E) 29	-		[S8]
	NW	(d) 60-310	-	(ε_f) 0.077	Brittle fracture, no size effect in ε_f	[S9]
	NW	(d) 85-542	-	(ε_f) 0.04-0.07	Brittle fracture	[S10]
	NW	(d) 18-304	(E) 133	(σ_f) 3.9-7.0	d↓⇒ σ_f↑, no size effect in E, brittle fracture	[S11]
	NW	(d) 70-110	(E) 148	(σ_f) 1.8-4.4 (ε_f) 0.002-0.007	Brittle fracture	[S12]
	NW	(d) 520-680	(E) 29.37	-	-	[S13]
	NW	(d) 40-400	(E) 147.3-249.3	-	d↓⇒E↑, core-shell model, ductile-to-brittle transition, amorphization	[S14]
	NB	(w) 90-125 (t) 70-115	(E) 105-162	-	-	[S15]
	NB	(w) 120-350 (t) 50-150	(E) 40-88	-	Humidity↑⇒E↑	[S16]
	NR	(d) 97-113	(E) 29, 34,	-	<11-20>, <10-10> direction	[S17]
Uniaxial test	NW	(d) 200-500	(E) 21	(ε_f) 0.05-0.15	d↓ ⇒ε_f↑, brittle fracture	[S18]
	NW	(d) 20-512	-	(σ_f) 3.35-9.53 (ε_f) 0.023-0.062	d↓ ⇒σ_f↑, brittle fracture	[S19]
	NW	(d) 20-80	(E) 130-170	(σ_f) 4.10-10.32 (ε_f) 0.03-0.06	Size effect, brittle fracture	[S20]
	NW	(d) 18-114	-	(ε_f) 0.02-0.065	d↓⇒ ε_f↑, brittle fracture	[S21]
	NW	(d) 350-520	(E) 57.15	-	-	[S13]
	NW	(d) 60-310	(E) 97	(σ_f) 3.7-5.5	Brittle fracture	[S9]
	NP	(d) 1000	(E) 123	(σ_y) 3	Pyramidal slip	[S22]
Buckling test	NW	(d) 20-80	(E) 140-210	(σ_f) 4.10-10.32 (ε_f) 0.03-0.06	Core-shell model, brittle fracture	[S20]
	NW.F	(d) 30, 100	-	(σ_b) 806, 723	-	[S23]
	NW.F	(d) 300-600	(E) 64.6-345.7	(σ_b) 0.1-0.55 (ε_b) 0.0011-0.0016	d↓ ⇒E & σ_y↑	[S24]
	NR.F, NT.F	(d) 208, (d_{out}) 208, (d_{inner}) 125	-	(σ_b) 0.006765, 0.0025	-	[S25]
Resonance test	NW	(d) 17-550	(E) 140-220	-	d↓⇒E↑	[S26]
	NW	(d) 30-100	(E) 58, 99		(0 0 0 1), (-1 0 1 0) plane	[S27]
	NW	(w) 28-55, (t) 19-39	(E) 52	-	-	[S28]

Table S2. Diffusivities of Zn and O in ZnO and at 298 K and ratio to surface diffusivity.

Zn diffusion

Path	T_{exp} [K]	D_o [m^2/s]	Q [J/atom]	D [m^2/s]	D_{surf}/D	Ref
Lattice	1273-1523	1.30×10^{-09}	3.02×10^{-19}	1.54×10^{-41}	3.85×10^{13}	[S29]
Lattice	1073-1673	1.00×10^{-05}	6.19×10^{-19}	4.75×10^{-71}	1.24×10^{43}	[S30]
GB		1.00×10^{-1}	4.80×10^{-19}	2.27×10^{-52}	2.60×10^{24}	
Lattice	1173-1673	3.00×10^{-4}	4.59×10^{-19}	1.09×10^{-52}	5.45×10^{24}	[S31]
Lattice	485-994	7.26×10^{-10}	2.88×10^{-19}	2.56×10^{-40}	2.31×10^{12}	[S32]
Lattice	1123-1293	1.73×10^{-2}	6.18×10^{-19}	1.03×10^{-67}	5.75×10^{39}	[S33]
Lattice	1300-1650	1.57×10^{-7}	4.26×10^{-19}	1.56×10^{-52}	3.79×10^{24}	[S34]
GB		1.59×10^{-3}	3.91×10^{-19}	8.34×10^{-45}	7.09×10^{16}	
Lattice	700-1200	4.54×10^{-7}	4.55×10^{-19}	4.07×10^{-55}	1.45×10^{27}	[S35]

O diffusion

Path	T_{exp} [K]	D_o [m^2/s]	Q [J/atom]	D [m^2/s]	D_{surf}/D	Ref
Lattice	1273-1523	6.50×10^{7}	1.15×10^{-18}	5.11×10^{-114}	1.16×10^{86}	[S29]
Lattice	1423-1673	1.05×10^{-1}	6.57×10^{-19}	4.54×10^{-71}	1.30×10^{43}	[S36]
Lattice (a-axis)	1123-1473	4.00×10^{-11}	3.56×10^{-19}	1.11×10^{-48}	5.35×10^{20}	[S37]
Lattice (c-axis)		9.00×10^{-10}	4.04×10^{-19}	2.09×10^{-52}	2.83×10^{24}	
Lattice (a-axis)		1.52×10	6.54×10^{-19}	1.43×10^{-68}	4.13×10^{40}	
Lattice (c-axis)		5.50×10^{-05}	6.07×10^{-19}	4.18×10^{-69}	1.42×10^{41}	
Lattice (a-axis)	1203-1323	1.50×10	8.15×10^{-19}	1.22×10^{-85}	4.86×10^{57}	[S38]
Lattice (c-axis)		1.20×10^{4}	9.48×10^{-19}	9.14×10^{-97}	6.47×10^{68}	
GB		5.00×10^{-7}	4.95×10^{-19}	2.81×10^{-59}	2.11×10^{31}	
Lattice	1173-1273	4.15×10^{-8}	3.71×10^{-19}	2.67×10^{-47}	2.22×10^{19}	[S39]
GB		5.51×10^{-2}	4.43×10^{-19}	9.28×10^{-49}	6.38×10^{20}	
Near interface	1093-1393	6.70×10^{-5}	5.74×10^{-19}	1.44×10^{-65}	4.10×10^{37}	[S40]
Near surface		3.20×10^{-3}	6.59×10^{-19}	7.87×10^{-73}	7.52×10^{44}	
Lattice	1073-1273	1.30×10^{-11}	3.60×10^{-19}	1.16×10^{-49}	5.09×10^{21}	[S41]
GB		5.90×10^{-6}	3.54×10^{-19}	2.65×10^{-43}	2.23×10^{15}	

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