

Supporting Information

Self-Healing Nanophotonics: Robust and Soft Random Lasers

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Table S1. Comparison of laser performance, deformability, and self-healability of various soft random lasers.

Soft matrix	Gain media	Threshold	Flexibility	Stretchability	Healability	Reference
	/Scattering media	/FWHM				
PDMS	ZnO brushes /ZnO brushes	72.1 μJ /1.1 nm	-	30%	✗	1
PDMS	Perovskite nanocrystals /Wrinkled structure from reduced graphene oxide (rGO)	10 $\mu\text{J cm}^{-2}$ /0.4 nm	-	100%	✗	2
PDMS	R6G(dye) /Ag nanowire (surface plasmon resonance)	0.31 mW cm^{-2} /5 nm	✓	30%	✗	3
PMMA	ZnO NPs /ZnO NPs	79 μJ /0.5 nm	-	100%	✗	4
PPC	PF8(dye) /PF8-PPC	0.3 mJ cm^{-2} /3 nm	✓	✗	✗	5
Polycarbonate	ZnO NPs /ZnO NPs and In ₂ O ₃ NPs	0.8 mW cm^{-2} /5 nm	✓	✗	✗	6
Butterfly wing	ZnO NPs /ZnO NPs and butterfly wing	65 μJ /< 1 nm	✓	✗	✗	7
Bacterial cellulose membrane	R6G /Ag NPs (surface)	2.5 mJ pulse^{-1} /4 nm	✓	✗	✗	8

PVA and sodium tetraborate	Stilbene 420 /Ag NPs	57 mJ cm ⁻² /3 nm	✓	100%	✓	This work

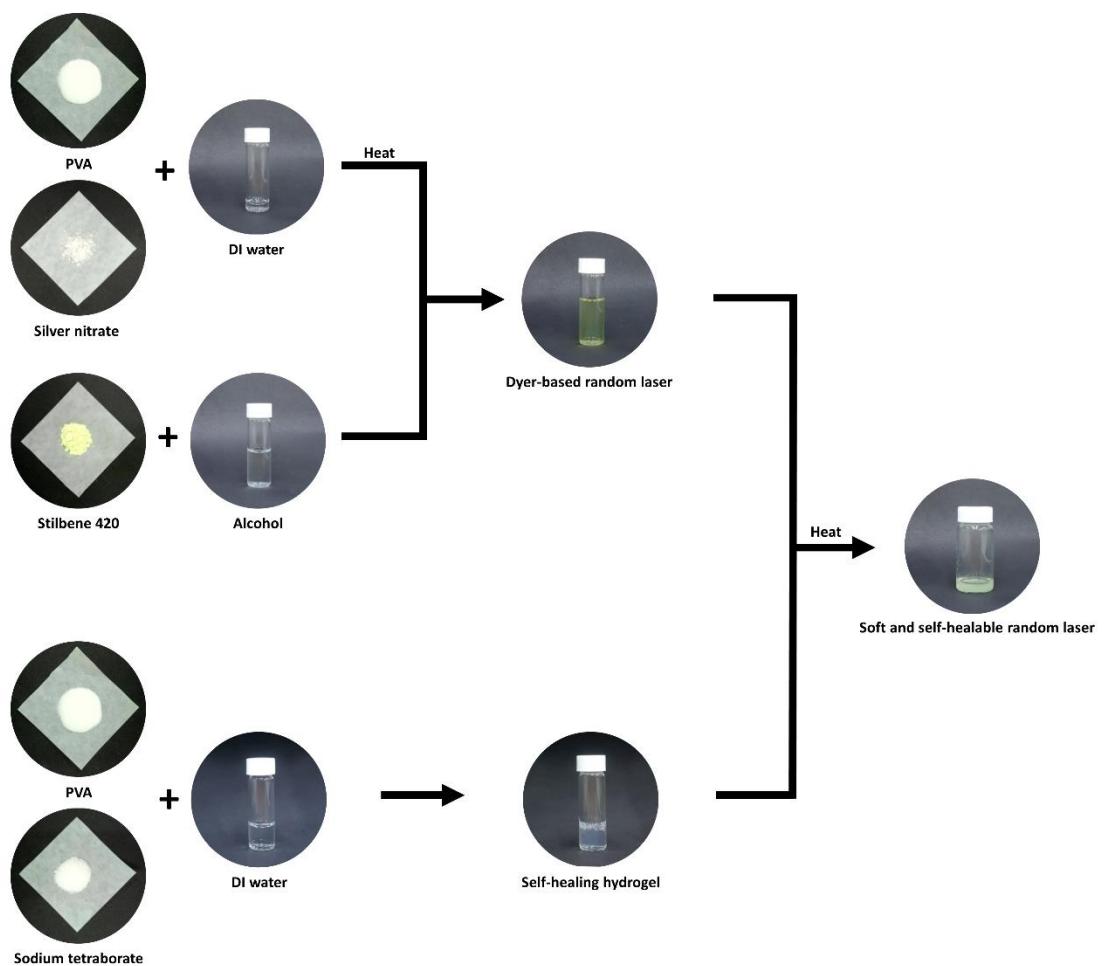


Figure S1. Synthesis process of SSRLs.

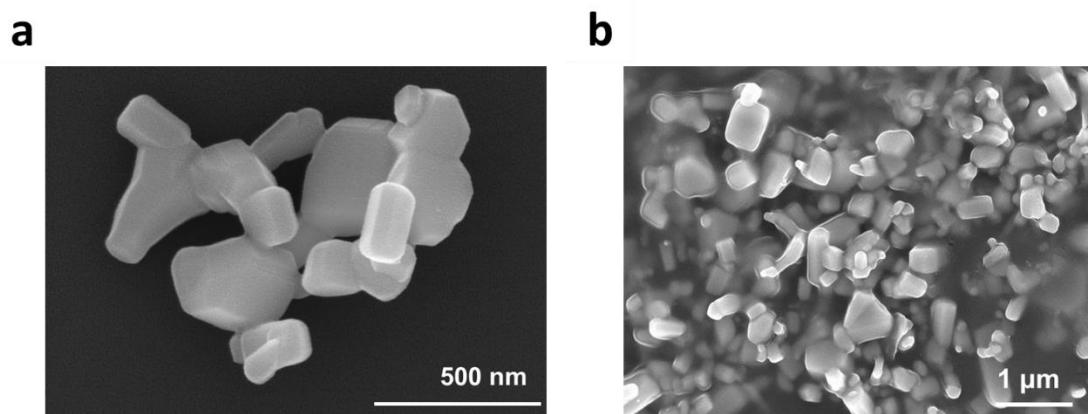


Figure S2. Scanning electron microscope (SEM) images of (a) ZnO NPs and (b) ZnO-SSRLs.

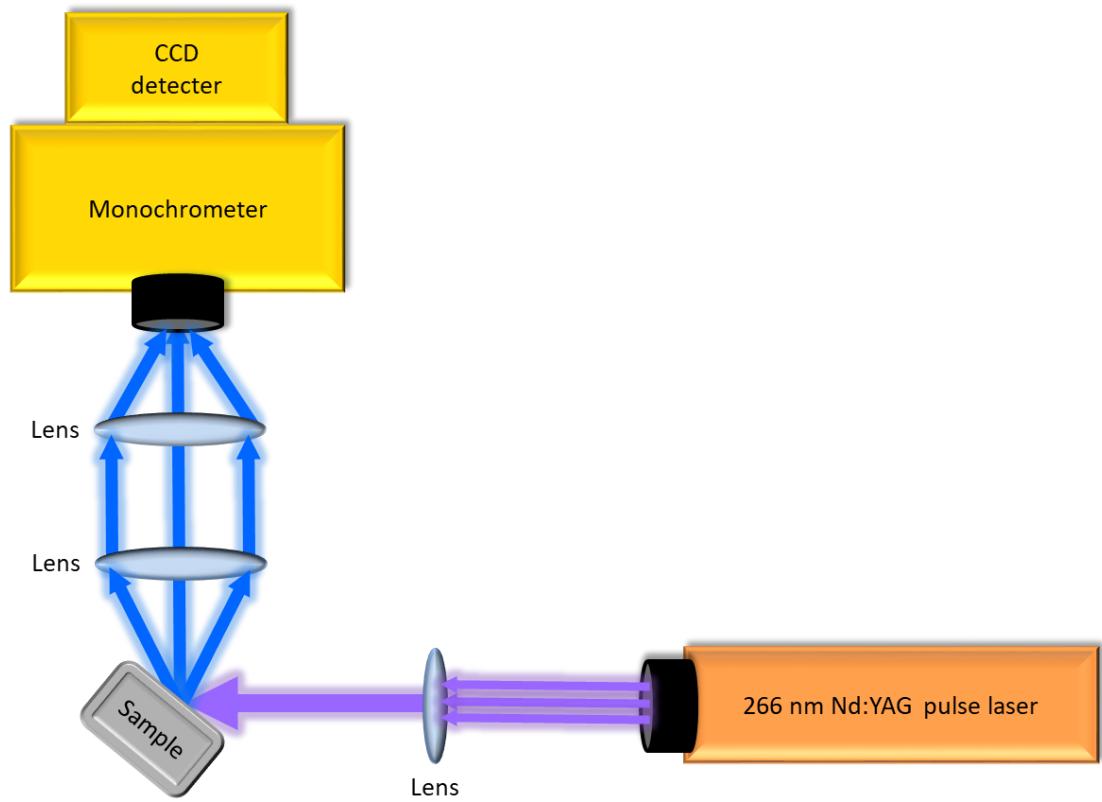


Figure S3. Scheme of the spectroscopic random laser setup.

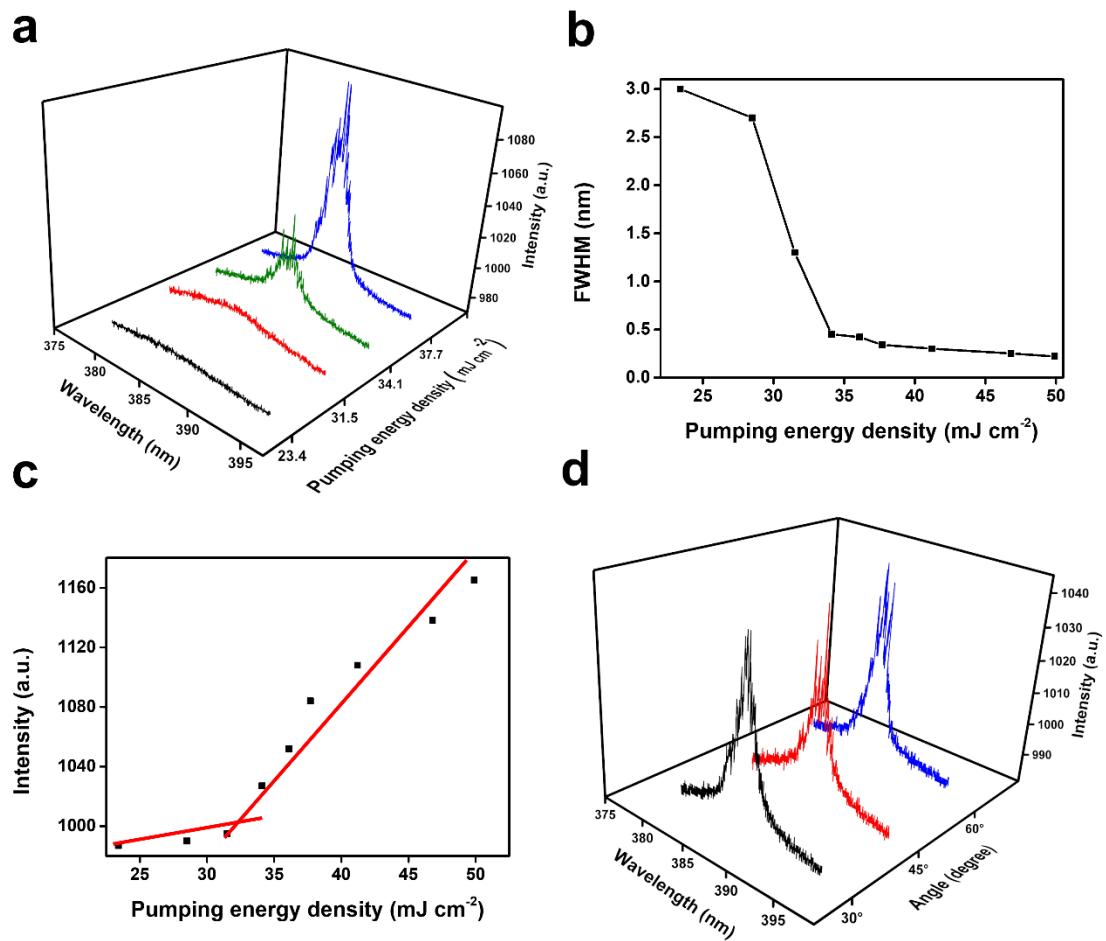


Figure S4. Performance of ZnO-SSRLs. (a) Emission spectra as a function of pumping energy density. (b) Full width at half-maximum (FWHM) as a function of pumping energy density. (c) Light-in-light-out curve of ZnO-SSRLs. (d) Angle-dependent random laser spectra.



Figure S5. Recovery process of SSRL.

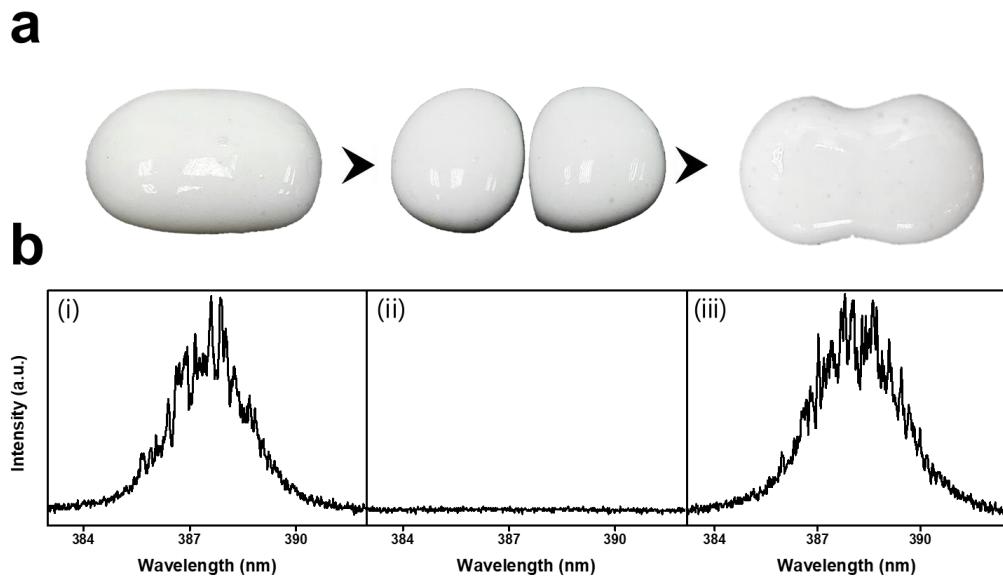


Figure S6. Self-healing capability of ZnO-SSRLs. (a) Photographs of self-healing process of the representative ZnO-SSRLs sample. (b) The corresponding random laser emission of ZnO-SSRLs under different healing stages.

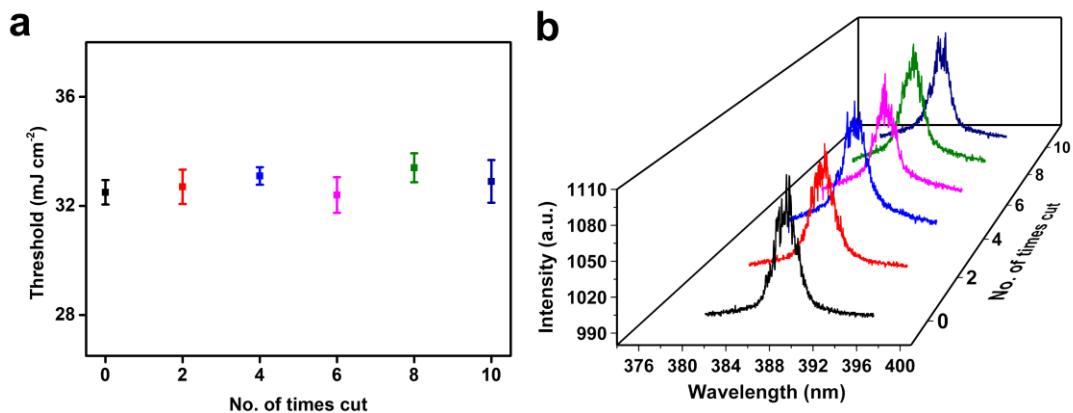


Figure S7. Durability of ZnO-SSRLs. (a) Corresponding evolution of laser threshold as a function of different cutting/healing test cycles. (b) A series of laser spectra measured at different cutting/healing test cycles.

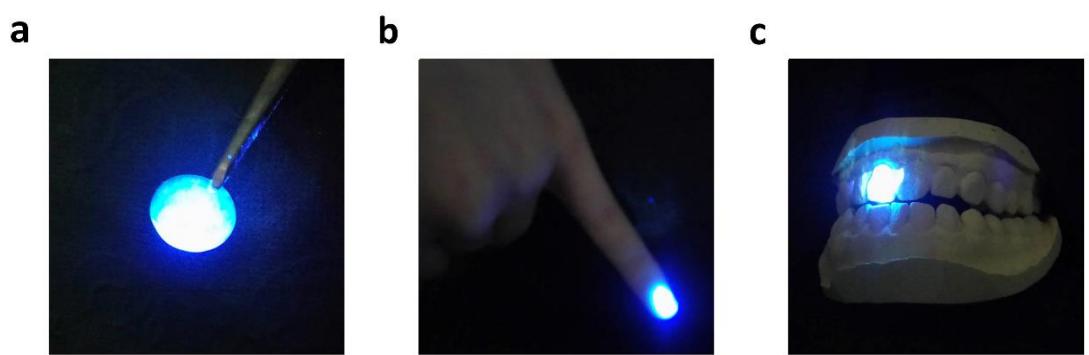


Figure S8. SSRLs as wearable devices. (a) SSRL attached on a contact lens. (b) SSRL placed on a finger nail (c) SSRL installed on a tooth.

Table S2. Threshold of SSRLs with different concentrations of stilbene 420.

Concentration (mg mL⁻¹)	12	24	120	240
Threshold (mJ cm⁻²)	63.9	57.8	64.1	x

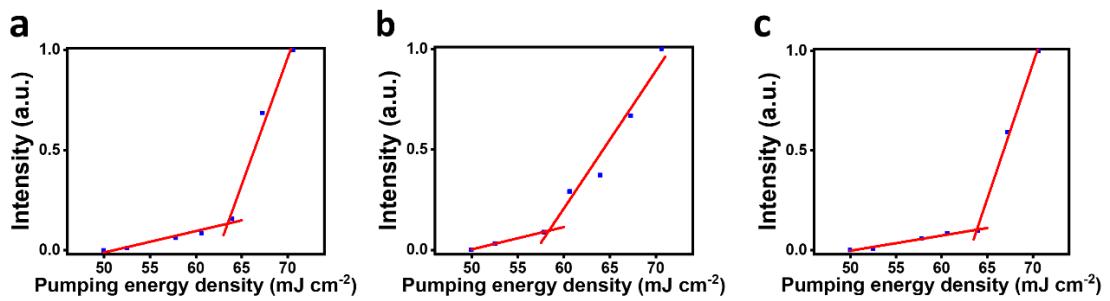


Figure S9. Light-in-light-out curve of SSRLs with different concentrations of stilbene 420. (a) 12 mg mL^{-1} (b) 24 mg mL^{-1} (c) 120 mg mL^{-1} .

Table S3. Threshold of SSRLs with different concentrations of silver nanoparticles.

Concentration (mg L⁻¹)	5	10	50	100
Threshold (mJ cm⁻²)	60.8	57.8	58.5	58.8

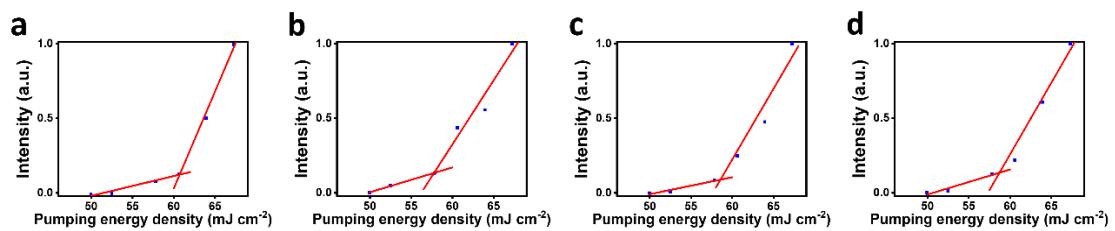


Figure S10. Light-in-light-out curve of SSRLs with different concentrations of silver nanoparticles. (a) 5 mg L⁻¹ (b) 10 mg L⁻¹ (c) 50 mg L⁻¹ (d) 100 mg L⁻¹.

Table S4. Dielectric permittivity of polymers with frequency within the range from 10^6 Hz to 10^7 Hz at room temperature.

Polymer	Dielectric Permittivity	Reference
Poly(vinyl alcohol) (PVA)	2.0	⁹
Poly(dimethylsiloxane) (PDMS)	3.5	¹⁰
Poly(vinylidene fluoride) (PVDF)	4.0	¹¹
Poly(methyl methacrylate) (PMMA)	4.9	¹²

Table S5. Threshold of random laser with different polymer-based matrices.

Polymer	PVA	PDMS	PVDF	PMMA
Threshold (mJ cm ⁻²)	58.6	57.9	58.2	58.7

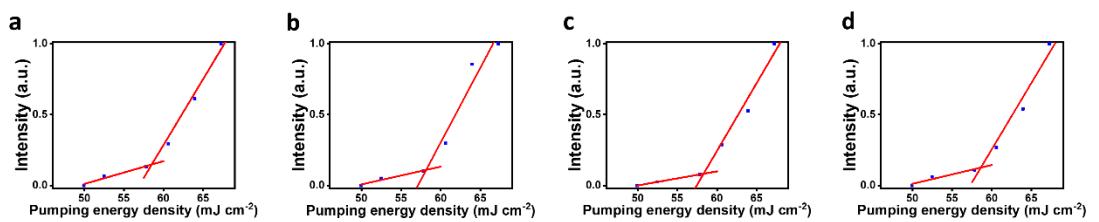


Figure S11. Light-in-light-out curve of random laser with different polymer-based matrices. (a) PVA (b) PDMS (c) PVDF (d) PMMA.

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