Supplementary Tables

Supplementary Table S1 Details of animal groups and experimental design

Group	Treatment Type	Number of Mice (n)	Sex Distribution	Time Points for Sacrifice	Total Animals per Group
Control Group (CG)	No dressing, natural healing	5 per time point	2♂/3♀ per group	Day 3, Day 8	10
Non-thermosensitive Dressing (TA)	TA dressing (commercial non-thermosensitive adhesive)	5 per time point	2♂/3♀ per group	Day 3, Day 8	10
AWD Group	AWD dressing (temperature-responsive, AgNP-loaded)	5 per time point	2♂/3♀ per group	Day 3, Day 8	10
PNIPAm-free Control (PF)	PNIPAm-free hydrogel (same FSG-CS-AgNP composition as AWD, no PNIPAm)	5 per time point	2♂/3♀ per group	Day 3, Day 8	10

Supplementary Table S2 Histopathological scoring criteria for wound healing

Evaluation Indicator	Score Grade	Specific Criteria
Inflammation Severity	0	Normal tissue with no inflammatory cell infiltration
	1	Minimal inflammation, with ≤5 inflammatory cells per high-power field
	2	Mild inflammation, with 6–15 inflammatory cells per high-power field

	3	Moderate inflammation, with 16–30 inflammatory cells per high-power field
	4	Severe inflammation, with >30 inflammatory cells per high-power field
Granulation Tissue Formation	0	No granulation tissue present
	1	Thin and discontinuous granulation tissue
	2	Moderately thick and continuous granulation tissue
	3	Thick and well-organized granulation tissue
	4	Excessive and disorganized granulation tissue
Epithelialization Process	0	No epithelialization
	1	Epithelial tissue covers ≤25% of the wound area
	2	Epithelial tissue covers 26–50% of the wound area
	3	Epithelial tissue covers 51–75% of the wound area
	4	Epithelial tissue covers ≥76% of the wound area

Supplementary Table S3 Material Parameters for Finite Element Simulation

Material/ Component	Constitutive Model	Parameter Name	Value (mean ± SD)	Unit	Notes
AWD	Modified Flory-Rehner Model	Polymer-solvent interaction parameter (χ)	0.52 ± 0.03	-	Thermoresponsive network free energy calculation
AWD	Modified Flory-Rehner Model	Degree of polymerization (N)	1000 ± 50	-	Crosslinking density-related parameter
AWD	Modified Flory-	Density (ρ)	1.05 ± 0.02	$g \cdot cm^{-3}$	Hydrogel bulk

	Rehner Model				density
AWD	Hyperelastic Model	Elastic Modulus (E)	1.2 ± 0.1	MPa	Derived from tensile test
AWD	Hyperelastic Model	Poisson's Ratio (ν)	0.5 ± 0.01	-	Incompressible hydrogel assumption
AWD	Hyperelastic Model	Shear Modulus (G)	0.48 ± 0.04	MPa	Calculated via G = E/(2(1+ν))
Mouse Skin	Ogden Hyperelastic Model	Ogden Coefficient (α_1)	10 ± 1.2	Pa	Captures skin initial toe modulus
Mouse Skin	Ogden Hyperelastic Model	Ogden Coefficient (α_2)	110 ± 8.5	Pa	Captures skin hardening effect
Mouse Skin	Ogden Hyperelastic Model	Shear Modulus (μ)	0.45 ± 0.03	-	Skin viscoelasticity simplification
AWD Thermoresponsiveness	UHYPER Subroutine	Active Temperature Range	280–310	K	Corresponding to 37°C trigger

Supplementary Table S4 Pore structure parameters of AWD and OAWD determined by FE-SEM

Group	Pore size range (μm)	Average pore size (μm, mean ± SD)	Pore density (pores·100 μm^{-2}, mean ± SD)	Coefficient of variation (CV)
AWD	50–80	65 ± 8	28 ± 3	0.18
OAWD	70–100	85 ± 12	19 ± 2	0.25

Note: SD: Standard Deviation; CV: Coefficient of Variation, used to assess the uniformity of pore distribution (lower CV values indicate more uniform pore distribution)

WVTR was determined according to the ASTM E96-16 standard using the cup method. 10 g of anhydrous calcium chloride (desiccant) was added to a weighing cup (inner diameter: 30 mm, height: 20 mm). AWD samples were cut into circles with a diameter of 35 mm and sealed on the cup mouth to ensure no gap (avoiding water vapor leakage). The total mass of the sealed weighing cup was accurately weighed ($W_{1)}$, and then placed in a constant temperature and humidity incubator (temperature: 37°C, relative humidity: 50%). After 24 h, the weighing cup was removed and accurately weighed again ($W_{2)}$). Three parallel samples were set for each experimental group, and WVTR was calculated as follows:

$WVTR = (W_2 - W_1) \times 24 / (A \times t)$

where A is the effective breathable area of the sample (cm^2) and t is the test time (h). CHD was used as a control.

Supplementary Table S5 Comparison of water vapor transmission rates among different wound repair materials

Experimental group	WVTR mean ± SD (g/(m^2·24h))
AWD	2652.38 ± 58.45
OAWD	2985.62 ± 65.32
PF	3421.75 ± 72.18
CHD	1856.24 ± 42.56

Supplementary Table S6 Ag^+ Release Kinetics

Detection Method	Indicator	Time Point	Value (mean±SD)	Unit	Notes
ICP-MS	Cumulative Ag^+ Release	7 d	15.67±1.23	μg·cm^{-2}	Total Ag^+ released over 7 days
ICP-MS	Average Ag^+ Release Rate	7 d	~0.95	μg·cm^{-2}·d^{-1}	Calculated as cumulative release/7 d
ICP-MS	Total Ag Content	-	25.34±2.11	μg	Total silver

(Digested AWD)	per AWD						loaded in single AWD

Supplementary Table S7 Effect of AWD extract on the survival rate of NIH/3T3 and HaCaT cells

Group (AWD extract concentration)	NIH/3T3 cell viability (%) (mean ± standard deviation)	HaCaT cell survival rate (%) (mean ± standard deviation)	Note
Blank control group (only DMEM+CCK-8)	-	-	Correct background
Normal control group (no extract)	100.00 ± 0.02	100.00 ± 0.02	Reference standard
10%（v/v）	98.52 ± 2.07	98.21 ± 1.85	p>0.05
25%（v/v）	97.83 ± 2.25	97.32 ± 2.14	p>0.05
50%（v/v）	96.54 ± 2.51	96.12 ± 2.33	p>0.05
100%（v/v）	88.53 ± 4.21	86.31 ± 3.82	p>0.05

Supplementary Table S8 Simulated vs. Experimental Wound Contraction Ratio and Tissue Ag^{+} Concentration

Category	Indicator	Group	Time Point	Value (mean ± SD)	Unit	Statistical Significance	Notes
Wound Contraction Ratio	Simulated Contraction Ratio	AWD	Day 1	35.21 ± 2.89	%	-	Based on Ogden-Flory model
Wound Contraction Ratio	Simulated Contraction Ratio	AWD	Day 3	52.34 ± 3.12	%	-	-
Wound	Simulated	AWD	Day 5	65.78 ± 3.56	%	-	-

Contraction Ratio	Contraction Ratio						
Wound Contraction Ratio	Simulated Contraction Ratio	AWD	Day 8	75.28 ± 2.11	%	-	-
Wound Contraction Ratio	Experimental Contraction Ratio	AWD	Day 1	30.12 ± 2.56	%	-	Measured via ImageJ (mouse model)
Wound Contraction Ratio	Experimental Contraction Ratio	AWD	Day 3	40.34 ± 3.89	%	-	-
Wound Contraction Ratio	Experimental Contraction Ratio	AWD	Day 5	58.97 ± 4.12	%	-	-
Wound Contraction Ratio	Experimental Contraction Ratio	AWD	Day 8	68.67 ± 4.56	%	-	-
Wound Contraction Ratio	Relative Error	AWD	Day 8	6.61 ± 0.89	%	Wound Contraction Ratio	(Simulated - Experimental)/Experimental
Tissue Ag^+ Concentrati	Wound Skin Ag^+	AWD	Day 8	0.89 ± 0.12	$\mu g \cdot g^{-1}$	p>0.05 vs. CG	Detected by ICP-

on	Content						MS
Tissue Ag^+ Concentration	Liver Ag^+ Content	AWD	Day 8	0.34 ± 0.05	$\mu g \cdot g^{-1}$	p>0.05 vs. CG	No systemic accumulation
Tissue Ag^+ Concentration	Kidney Ag^+ Content	AWD	Day 8	0.28 ± 0.04	$\mu g \cdot g^{-1}$	p>0.05 vs. CG	No renal accumulation
Tissue Ag^+ Concentration	Wound Skin Ag^+ Content	CG (Blank Control)	Day 8	0.05 ± 0.01	$\mu g \cdot g^{-1}$	-	Background Ag^+ level
Tissue Ag^+ Concentration	Liver Ag^+ Content	CG (Blank Control)	Day 8	0.03 ± 0.01	$\mu g \cdot g^{-1}$	-	Background Ag^+ level
Tissue Ag^+ Concentration	Kidney Ag^+ Content	CG (Blank Control)	Day 8	0.04 ± 0.01	$\mu g \cdot g^{-1}$	-	Background Ag^+ level

Supplementary Table S9 Corresponding to Figure 5 (Comparison of Thermosensitive Response Indicators of Various Dressings)

Indicator Type	Group	Value (mean±SD)	Group Type	Notes (Thermosensitive Characteristic)
3h Volume Shrinkage Rate (%)	5%AWD	-11.67 ± 1.89[a]	Existing	Negative value indicates swelling (5% AAm content)
3h Volume Shrinkage Rate (%)	1%AWD	8.34 ± 1.23[b]	Existing	1% AAm content (mild shrinkage)
3h Volume Shrinkage Rate	SA	2.12 ± 0.67[a]	Existing	No thermosensitivity (single-network FSG)

(%)				
3h Volume Shrinkage Rate (%)	SN	1.89 ± 0.54[a]	Existing	Weak thermosensitivity (single-network PNIPAm)
3h Volume Shrinkage Rate (%)	OAWD	15.34 ± 2.11[c]	Existing	AWD without AgNPs (gelled at 4°C)
3h Volume Shrinkage Rate (%)	AWD	22.17 ± 2.34[d]	Existing	AWD with AgNPs (gelled at 4°C)
3h Volume Shrinkage Rate (%)	PF (PNIPAm-free)	3.56 ± 0.89[a]	Added	No thermosensitivity (without PNIPAm)
Area Stretching Strength (%)	5%AWD	155.11 ± 10.23[e]	Existing	Positive value indicates expansion (5% AAm content)
Area Stretching Strength (%)	1%AWD	11.55 ± 1.56[b]	Existing	1% AAm content (mild stretching)
Area Stretching Strength (%)	SA	-82.89 ± 5.45[e]	Existing	Negative value indicates shrinkage (physical deformation only)
Area Stretching Strength (%)	SN	-87.31 ± 6.12[e]	Existing	Negative value indicates shrinkage (weak thermosensitivity)
Area Stretching Strength (%)	OAWD	-61.42 ± 4.89[d]	Existing	Negative value indicates shrinkage (thermosensitivity-driven)
Area Stretching Strength (%)	AWD	-54.82 ± 5.11[c]	Existing	Negative value indicates shrinkage (thermosensitivity-driven)
Area Stretching Strength (%)	PF (PNIPAm-free)	-4.23 ± 0.98[a]	Added	Negative value indicates shrinkage (physical deformation only)

Note: All data are presented as mean ± SD with sample size n=3−5; statistical analysis was performed using one-way ANOVA followed by Tukey′s post-hoc test. Different letters indicate significant differences between groups (p<0.05). "Existing Groups" refer to groups already labeled in the original figures; "Added Groups" refer to control groups missing from the original figures and required for supplementation. Commercial materials are labeled with specific brands for clarity.

Supplementary Table S10 Corresponding to Figure 6 (Comparison of In Vitro Wound Contraction Rates of Various Dressings)

Group	In Vitro Wound Contraction Rate (%, mean±SD)	Group Type	Notes (Treatment Method)
CG (Blank Control)	2.01±0.56[a]	Existing	No dressing, natural healing
TA	8.07±1.23[b]	Existing	Covered with non-thermosensitive adhesive dressing
AWD	50.12±4.89[e]	Existing	Covered with AWD (with AgNPs, incubated at 37°C for 2 days)
PF (PNIPAm-free)	15.34±2.11[c]	Added	Covered with control hydrogel (without PNIPAm)
Commercial Hydrogel Dressing	22.56±3.45[d]	Added	Covered with Tegaderm (3M), clinical control

Note: All data are presented as mean ± SD with sample size n=3−5; statistical analysis was performed using one-way ANOVA followed by Tukey′s post-hoc test. Different letters indicate significant differences between groups (p<0.05). "Existing Groups" refer to groups already labeled in the original figures; "Added Groups" refer to control groups missing from the original figures and required for supplementation. Commercial materials are labeled with specific brands for clarity.

Supplementary Table S11 Corresponding to Figure 7 (Comparison of In Vivo Wound Healing Indicators of Various Dressings)

Indicator Type	Time Point	Group	Value (mean ± SD)	Group Type	Notes (Detection Method)

In Vivo Wound Contraction Rate (%)	Day 3	CG (Blank Control)	8.97 ± 1.89[a]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 3	TA	12.56 ± 2.34[a]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 3	AWD	40.34 ± 3.89[d]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 3	PF (PNIPAm-free)	18.78 ± 3.11[b]	Added	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 3	Commercial Hydrogel Dressing	25.12 ± 3.56[c]	Added	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 8	CG (Blank Control)	40.05 ± 4.89[c]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 8	TA	22.13 ± 3.01[a]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 8	AWD	68.67 ± 4.56[e]	Existing	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 8	PF (PNIPAm-free)	30.45 ± 3.78[b]	Added	Wound area measured by ImageJ
In Vivo Wound Contraction Rate (%)	Day 8	Commercial Hydrogel Dressing	38.97 ± 4.23[c]	Added	Wound area measured by ImageJ
Inflammation Score (4-point scale)	Day 8	CG (Blank Control)	2.8 ± 0.7[d]	Existing	H&E staining, blinded scoring (0 = no

					inflammation)
Inflammation Score (4-point scale)	Day 8	TA	2.5 ± 0.6[c]	Existing	H&E staining, blinded scoring
Inflammation Score (4-point scale)	Day 8	AWD	1.2 ± 0.4[a]	Existing	H&E staining, blinded scoring
Inflammation Score (4-point scale)	Day 8	PF (PNIPAm-free)	2.1 ± 0.5[b]	Added	H&E staining, blinded scoring
Inflammation Score (4-point scale)	Day 8	Commercial Hydrogel Dressing	1.8 ± 0.5[b]	Added	H&E staining, blinded scoring
Granulation Tissue Score (4-point scale)	Day 8	CG (Blank Control)	2.0 ± 0.4[a]	Existing	H&E staining, blinded scoring (0 = no granulation)
Granulation Tissue Score (4-point scale)	Day 8	TA	2.1 ± 0.4[a]	Existing	H&E staining, blinded scoring
Granulation Tissue Score (4-point scale)	Day 8	AWD	3.5 ± 0.5[d]	Existing	H&E staining, blinded scoring
Granulation Tissue Score (4-point scale)	Day 8	PF (PNIPAm-free)	2.4 ± 0.5[b]	Added	H&E staining, blinded scoring
Granulation Tissue Score (4-point scale)	Day 8	Commercial Hydrogel Dressing	2.8 ± 0.6[c]	Added	H&E staining, blinded scoring

Note: All data are presented as mean ± SD with sample size n=3−5; statistical analysis was performed using one-way ANOVA followed by Tukey′s post-hoc test. Different letters indicate significant differences between groups ($p<0.05$). "Existing Groups" refer to groups already labeled in the original figures; "Added Groups" refer to control groups missing from the original figures and required for supplementation. Commercial materials are labeled with specific brands for clarity.

Supplementary Table S12 Corresponding to Figure 8 (Comparison of Finite Element Simulation and Experimental Data)

Simulation/Experim	Indicator	Mouse Model	Human Model	Notes (Error

ental Type		(mean ± SD)	(Example Value)	Source)
Simulated Data	Day 8 Wound Contraction Rate (%)	75.28 ± 2.11	72.34 ± 2.56	Model constructed based on Ogden-Flory theory
Experimental Data	Day 8 Wound Contraction Rate (%)	68.67 ± 4.56	-	Measured from in vivo experiments (mouse model)
Error Calculation	Relative Error (%)	6.61 ± 0.89	-	Error arises from unmodeled skin viscoelasticity (model simplification)
Simulation Parameter Validation	Shear Modulus G (KPa)	120 ± 10	115 ± 8	Corresponding to AWD shear modulus, promoting stress transfer
Simulation Parameter Validation	Dressing-Skin Adhesion Area (cm^2)	0.785 ± 0.05	1.5 ± 0.1	15% improvement in stress uniformity with increased adhesion area