Supporting information

Gellan gum modified hyaluronic acid hydrogel as viscosupplement

with lubrication maintenance and enzymatic resistance

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Formulation of model OA SF

The formulation of model OA SF refers to the formula of David Rebenda et al.¹ Phosphate buffer saline (PBS) was used as a basic solution to which albumin (24.9 mg/mL), γ -globulin (6.1 mg/mL), hHA (1.49 mg/mL) and phospholipids (0.34 mg/mL) were added. After dissolved in PBS overnight at 4 °C, deep freeze at – 20 °C until testing.

Worn surface morphology

Ultra-depth-field microscope (VHX-1000C, Keyence, Japan) was used to directly observe the wear surface morphology of the titanium sheet after the friction test for 150 s. Then, 3D depth simulation mode was used to simulate the surface morphology after the friction test.



Fig. S1 Viscosity-shear rate curve of different mass fractions of HA (a) Mw = 100 kDa, (b) $Mw = 1000 \sim 1500 \text{ kDa}$.



Fig. S2 FT-IR spectra of HEG-1, HEG-2 and HEG-3.



Fig. S3 (a) HEG-1, (b) HEG-2 viscosupplements and (c) HG-1, (d) HG-2, (e) HG-3 viscosupplements can pass through a needle. HG-2 and HG-3 viscosupplements have lost their liquidity.



Fig. S4 Strain sweep curve for viscosupplements of (a) HA, (b) HEG-1, (c) HEG-2, (d) HEG-3, (e) GG (f) ARTZ[®] and (g) Hyprojoint[®].



Fig. S5 Worn surface topographies and 3D simulation image of titanium sheets before friction tests: (a) Control and after friction tests: (b) DI; (c) HA solution under 2 wt% concentration; (d) ARTZ[®]; (e) Hyprojoint[®]; (f) HEG-1, (g) HEG-2, (h) HEG-3 viscosupplements under 2 wt% concentration.



Fig. S6 (a) Viscosity-shear rate curve of OA SF; (b) Frequency sweep curve of OA SF.



Fig. S7 Strain sweep curve for viscosupplements of (a) HA, (b) HEG-1, (c) HEG-2, (d) HEG-3, (e) GG (f) ARTZ®, (g) Hyprojoint® and (h) OA SF with HAse action for a week.



Fig. S8 DAPI/phalloidin staining of L929 cells co-cultured with viscosupplement for 3 days, showing cytoskeleton nuclei (blue) and fibrous actin (red).

References

1 D. Rebenda, M. Vrbka, D. Nečas, E. Toropitsyn, S. Yarimitsu, P. Čípek, M. Pravda and M. Hartl, *Tribol. Int.*, 2021, **160**, 107030.