Supporting Information

Injectable MAP hydrogel based on guest-host interlinked PEG microgels

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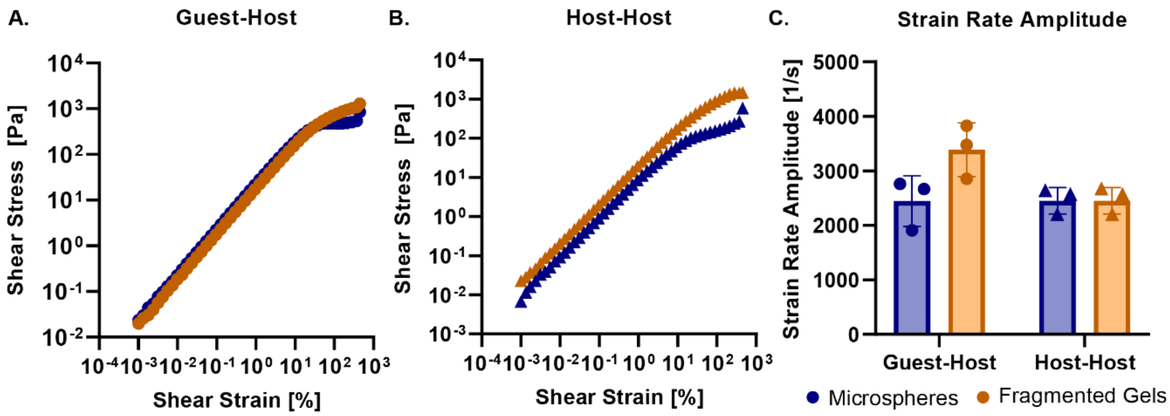

Figure S1. (A) Guest-host and (B) host-host microspheres and fragmented gels and shear stress v. shear strain from the oscillatory strain sweep (**Figure 3C, D**). Yield stress is determined by the change in slope. (B) Yield strain rate amplitude was determined by conducting strain-rate frequency superposition for each group.

Table S1. Islet Donor Information

Islet Preparation	Unique Identifier	Donor Age [years]	Donor Sex [M/F]	Donor Ethnicity	Donor BMI [kg m^{-2}]	Donor HbA1c	Origin/Source of Islets	Islet Isolation Center	Donor History of diabetes?
1	SAMN20478103	30	M	Hispanic	25.40	5.8%	IIDP	University of Pennsylvania	No
2	SAMN21400456	54	M	White	29.3	5.3%	IIDP	Southern California Islet Cell Resource Center	No

3	SAMN228114513	26	M	White	29.2	5.4%	IIDP	Southern California Islet Cell Resource Center	No
4	HP-22095-01	33	M	White	25.9	5.4%	PRODO Labs	PRODO Labs	No

Supplementary Derivation of Navier-Stokes Equations.

Case 1: 1X Phosphate Buffered Saline, 1 mL Syringe, 20 G Needle (Conical, no tapering)

- Assumptions:
    - Steady-state fully developed flow
    - No change in velocity along z or θ
    - Velocity component is only in the z-direction
    - Rheology: Newtonian
    - Neglect gravity (much smaller than pressure)

Using Navier Stokes Conservation of Momentum:

$$\rho\left[\frac{\partial v_z}{\partial t}+v_r\frac{\partial v_z}{\partial r}+v_\theta\frac{\partial v_z}{r\partial\theta}+v_z\frac{\partial v_z}{\partial z}\right]=\rho g_z-\frac{\partial P}{\partial z}+\left[\frac{1}{r}\frac{\partial(r\tau_{rz}}{\partial r}+\frac{1}{r}\frac{\partial\tau_{\theta z}}{\partial\theta}+\frac{\partial\tau_{zz}}{\partial z}\right]$$

Apply assumptions

$$\cancel{\rho}\left[\cancel{\frac{\partial v_z}{\partial t}}+\cancel{v_r\frac{\partial v_z}{\partial r}}+\cancel{v_\theta\frac{\partial v_z}{r\partial\theta}}+\cancel{v_z\frac{\partial v_z}{\partial z}}\right]=\cancel{\rho g_z}-\frac{\partial P}{\partial z}+\left[\frac{1}{r}\frac{\partial(r\tau_{rz}}{\partial r}+\cancel{\frac{1}{r}\frac{\partial\tau_{\theta z}}{\partial\theta}}+\cancel{\frac{\partial\tau_{zz}}{\partial z}}\right]$$

- *Pressure is only a function of z*
- *Shear and velocity are only a function of r*

$$0=-\frac{dP}{dz}+\left[\frac{1}{r}\frac{d(r\tau_{rz}}{dr}\right]$$

$$\frac{dP}{dz}=\left[\frac{1}{r}\frac{d(r\tau_{rz}}{dr}\right]$$

$$\frac{dP}{dz}=\left[\frac{1}{r}\frac{d(r\tau_{rz}}{dr}\right]=Constant, C_1$$

$$\frac{dP}{dz}=C_1$$

$$\int dP=\int C_1 dz$$

$$P=C_1 z+C_3$$

Apply Boundary Conditions

- B.C. $\Delta P = P_0 - P_1 \; @ \; z=0,\; z=L$

Where L = length of the needle

$$P(z=0)=P_0=C_1(0)+C_3$$

$$P(z=L)=P_L=C_1(L)+P_0$$

$$C_1=\frac{P_L-P_0}{L}=\frac{-\Delta P}{L}$$

$$P=\frac{-\Delta Pz}{L}+P_0$$

$$\frac{dP}{dz}=\frac{-\Delta P}{L}=\frac{1}{r}\frac{d(r\tau_{rz})}{dr}$$

$$\frac{-\Delta P r}{L} dr = d(r\tau_{rz})$$
$$-\int \frac{\Delta P r}{L} dr = \int d(r\tau_{rz})$$
$$\frac{-\Delta P r^2}{2L} + C_4 = r\tau_{rz}$$

General Solution for Shear Stress:

$$\frac{-\Delta P r}{2L} + \frac{C_4}{r} = \tau_{rz}$$

Use Rheology to solve for unique solution of Shear Stress:

Rheology for 1X PBS, Newtonian Fluid Model

$$\tau_{rz} = \mu \frac{dv_z}{dr} = \frac{-\Delta P r}{2L} + \frac{C_4}{r}$$

C_4 = 0, because shear has to be finite at r = 0

$$\frac{dv_z}{dr} = \frac{-\Delta P r}{2\mu L}$$
$$dv_z = (\frac{-\Delta P r}{2\mu L}) dr$$
$$\int dv_z = \int (\frac{-\Delta P r}{2\mu L}) dr$$
$$v_z = \frac{-\Delta P r^2}{4\mu L} + C_5$$

Apply Boundary Conditions:

- $v_z(r = R) = 0$
  - *Where R is the radius of the needle*
- $\frac{\partial v}{\partial r}(r = 0) = 0$

$$v_z = \frac{-\Delta P R^2}{4\mu L}(1 - \frac{r^2}{R^2})$$
$$\frac{dv_z}{dr} = \frac{-\Delta P R^2}{4\mu L} + \frac{\Delta P r}{2\mu L}$$
$$\tau_{rz} = \mu \frac{dv_z}{dr} = \frac{-\Delta P R^2}{4L} + \frac{\Delta P r}{2L}$$

Plug in for wall shear stress:

$$\boldsymbol{\tau_w = \frac{\Delta P R}{2L}(-\frac{R}{2} + 1)}$$

Case 2: Microspheres and Fragmented Gels

General Solution for Shear Stress:

$$\frac{-\Delta P r}{2L} + \frac{C_4}{r} = \tau_{rz}$$

Use rheology to solve for unique solution:

Rheology for Microspheres, Herschel-Bulkley Fluid Model

Using Magnon and Cayeux method we know that in turbulent flow, the wall shear stress is directly proportional to the pressure gradient:

$$\boldsymbol{\tau_w = \frac{R}{2}\frac{\Delta P}{L}}$$