Supporting information for:

**Nanostructured RF ink for 3D direct writing**

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**TABLE SI Absorbance corresponding to the concentration of different cell culture broth**

<table>
<thead>
<tr>
<th>Relative concentration</th>
<th>0.2</th>
<th>0.33333</th>
<th>0.4</th>
<th>0.5</th>
<th>0.66667</th>
<th>0.8</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>c/c₀ (g/ml)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absorbance</td>
<td>0.0952</td>
<td>0.20881</td>
<td>0.26164</td>
<td>0.32473</td>
<td>0.43734</td>
<td>0.54824</td>
<td>0.70133</td>
</tr>
</tbody>
</table>

**FIG. S1.** Cell culture fluid calibration curve
For the experiment, 3D CA (0.439g) was added into 30 mL Dulbecco's modified eagle medium (8.1 mg/L). The amount of phenol red indicator adsorbed per unit mass of 3D CA and the percentage of removal of phenol red indicator were calculated according to Eqs. (1) and (2), respectively:\(^1\)

\[
q = \frac{V(c_0 - c_t)}{m} \quad (1)
\]

\[
R = \frac{100(c_0 - c_t)}{c_0} \quad (2)
\]

Where \(q\) (adsorption capacity) is the amount of phenol red indicator adsorbed by 3D CA (mg/g), \(R\) (adsorption ratio) is the percentage of removal of phenol red indicator (%), \(c_0\) is the initial concentration of phenol red indicator solution (mg/L), \(c_t\) is the final (after adsorption) concentration (mg/L), \(V\) represents the volume of phenol red indicator solution (L) and \(m\) is the mass of 3D CA (g). The pseudo-first-order kinetic model can be expressed in nonlinear form as Eq. (3) and pseudo-second-order kinetic model can be formulated in linear form as Eq. (4) as follows:\(^1\)

\[
q_t = q_e \left[1 - \exp\left(-k_1t\right)\right] \quad (3)
\]

\[
\frac{t}{q_t} = \frac{1}{k_2q_e^2} + \frac{t}{q_e} \quad (4)
\]

Where \(q_t\) and \(q_e\) (mg/g) are the adsorption capacities at time (h) and equilibrium, respectively. \(k_1\) (g mg \(^{-1}\) h \(^{-1}\)) and \(k_2\) are the pseudo-first-order model rate constant and pseudo-second-order model rate constant, respectively. Fig. S2a and b show the fitted curves of pseudo-first-order kinetic model and pseudo-second-order kinetic model, respectively. The correlation coefficients \(R^2\), \(k_1\), \(k_2\) and the calculated \(q_e\) values (\(q_{e,\text{cal}}\)) are all shown in Table SII.
FIG. S2. Pseudo-first-order (a) and pseudo-second-order kinetics (b) for the adsorption of phenol red indicator onto the 3D CA.

### TABLE SII Kinetic models for the adsorption of phenol red indicator

<table>
<thead>
<tr>
<th>Models</th>
<th>Model coefficients</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudo-first-model</td>
<td>$q_{e,cal}=0.555 \text{ mg g}^{-1}$</td>
<td>0.9924</td>
</tr>
<tr>
<td></td>
<td>$k_1=1.172 \text{ g mg}^{-1} \text{ h}^{-1}$</td>
<td></td>
</tr>
<tr>
<td>Pseudo-second-model</td>
<td>$q_{e,cal}=0.697 \text{ mg g}^{-1}$</td>
<td>0.9921</td>
</tr>
<tr>
<td></td>
<td>$k_2=1.315 \text{ g mg}^{-1} \text{ h}^{-1}$</td>
<td></td>
</tr>
</tbody>
</table>

The Weber’s intraparticle diffusion model being expressed in linear form as Eq. (5) as follows:

$$q_t = k_i t^{1/2} + c$$  \hspace{1cm} (5)

Where $k_i (\text{mg g}^{-1} \text{ h}^{-1/2})$ is the intraparticle diffusion rate constant and $c (\text{mg/g})$ is a constant. The parameters of Weber intraparticle diffusion model are shown in Table SIII.
FIG S3 Intraparticle diffusion plots for the adsorption of phenol red indicator onto the 3D CA.

TABLE SIII Intraparticle diffusion model parameters for the adsorption of MB phenol red indicator

<table>
<thead>
<tr>
<th>k_{i,1}</th>
<th>c_1</th>
<th>R^2</th>
<th>k_{i,2}</th>
<th>C_2</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3965</td>
<td>-0.0743</td>
<td>0.9892</td>
<td>0.0992</td>
<td>0.3425</td>
<td>0.9363</td>
</tr>
</tbody>
</table>

REFERENCES


