Experimental supporting information

NIR light-responsive short peptide/2D $NbSe_2$ nanosheets composite hydrogel with controlled-release capacity

Can Wu, ‡[a] Jing Liu, ‡[a]Bin Liu, [a] Suyun He, [a] Guoru, Dai, [a] Bo Xu [b*], Wenying Zhong [ac*]

[a] Department of Analytical Chemistry, China Pharmaceutical University, Nanjing 210009, People's Republic of China

[b] Department of Physics, China Pharmaceutical University, Nanjing 210009, People's Republic of China

[C] Key Laboratory of Biomedical Functional Materials, China Pharmaceutical University, Nanjing 210009, People's Republic of China

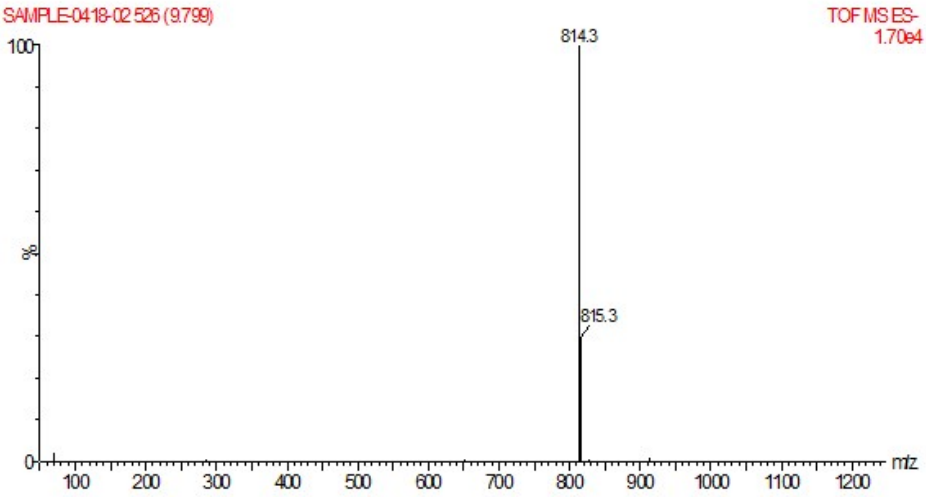
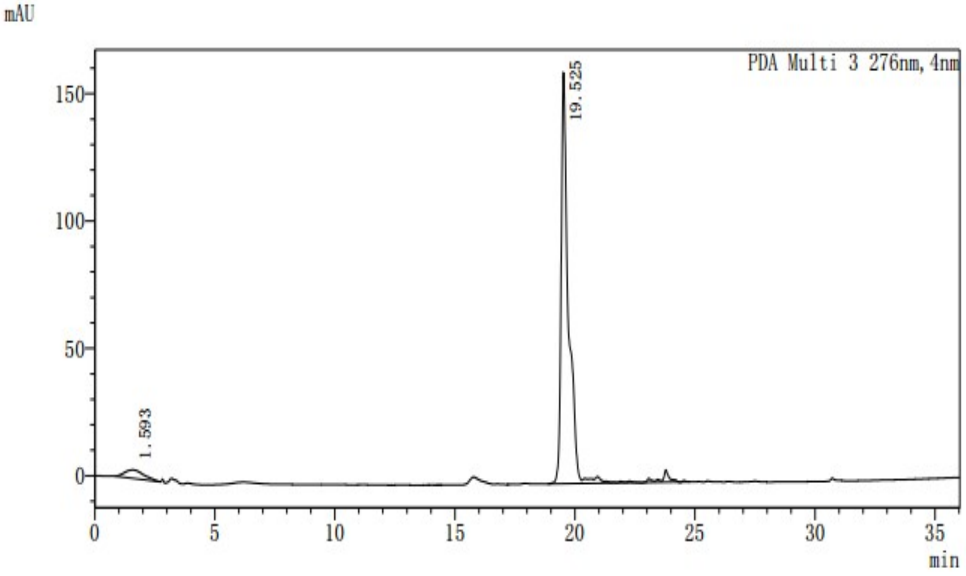


Fig. S1 MS spectra of YD peptide (m/z 814.3 [M-H])



Reversed phase high performance liquid phase conditions:
Mobile phase: A phase: 0.1% TFA- water; B phase: 0.1% TFA- Methanol

Elution conditions：

Time (min)	**A (%)**	**B (%)**
0-25	55-0	45-100
25-27	0	100
27-35	0-55	100-45

Fig. S2 The liquid chromatogram of YD peptide

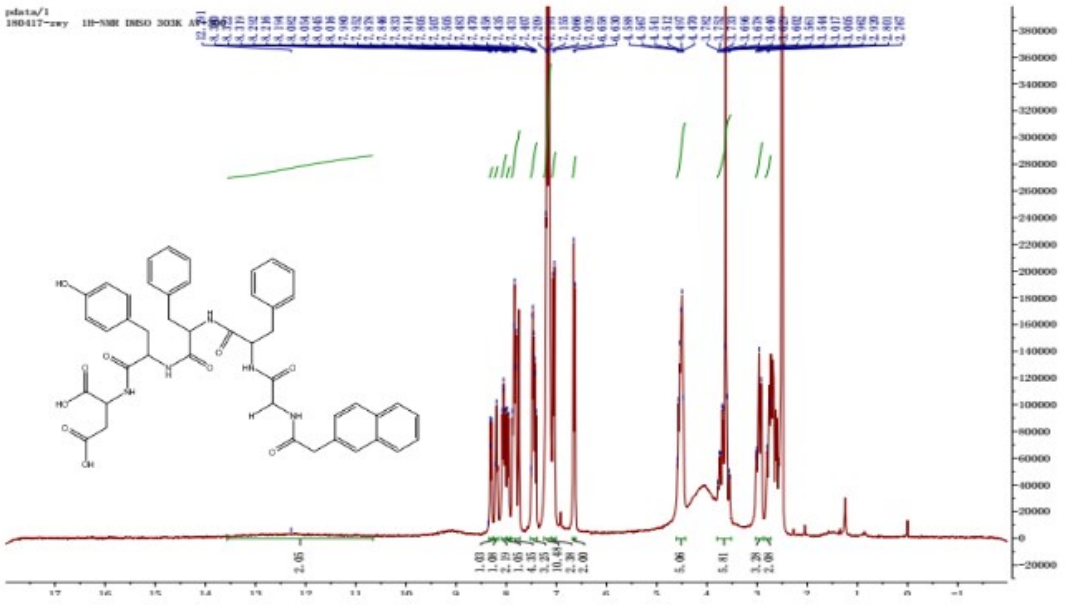


Fig. S3 ^{1}H-NMR spectra of YD peptide

δ= 12.291 (broad peak, 2H), 8.360-8.292 (d, J= 7.81, 1H), 8.216-8.194 (d, J= 5.55, 1H), 8.082-8.016 (m, 2H), 7.980-7.952 (d, J= 8.02, 1H), 7.878-7.805 (m, 4H), 7.507-7.407 (m, 3H), 7.209-7.155 (m, 10H), 7.066-7.039 (d, J= 7.97, 2H), 6.658-6.630 (d, J= 8.82, 2H), 4.588-4.470 (m, 5H), 3.782-3.544 (m, 6H), 3.017-2.920 (m, 2H), 2.801-2.767 (d, J= 11.16, 2H)

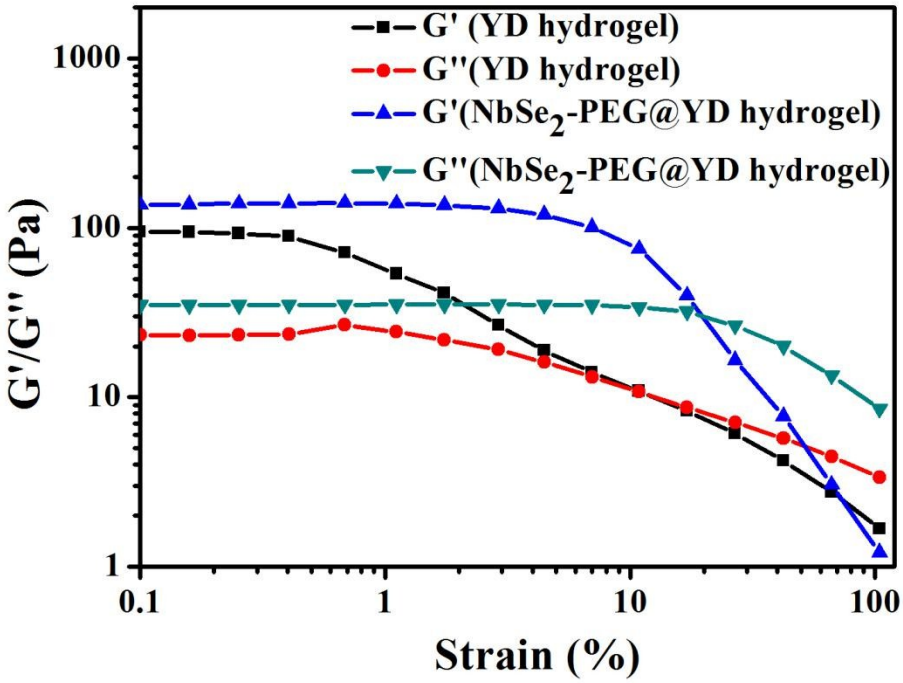


Fig. S4 Dynamic Strain Sweep Test of 2.0 wt% YD hydrogel and $NbSe_2$-PEG@YD hydrogel (Frequency: 6.28 rad/s; Strains: 0.1~100%)

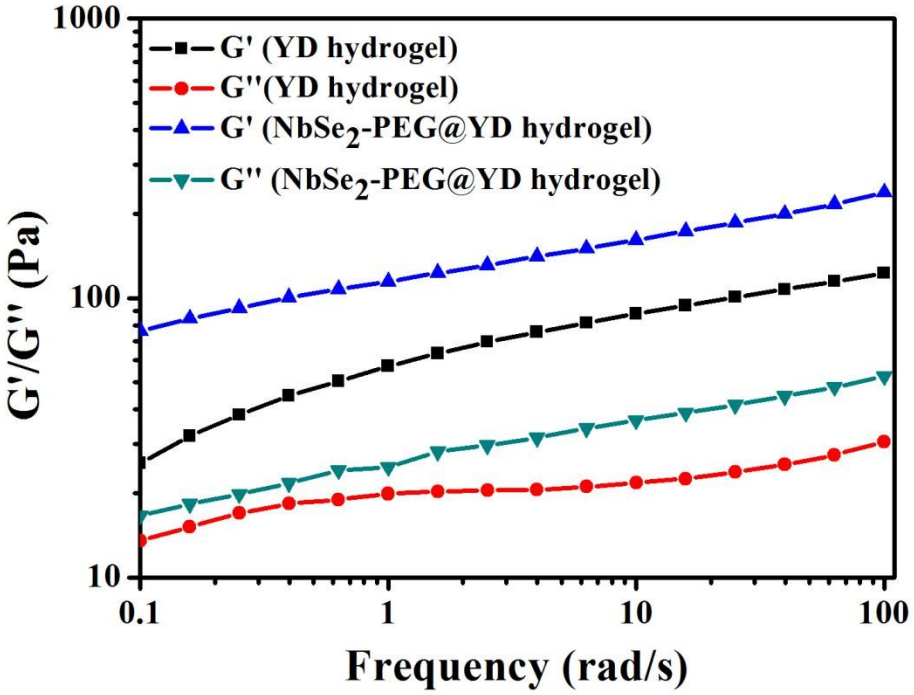


Fig. S5 Dynamic Frequency Sweep Test of 2.0 wt% YD hydrogel and $NbSe_2$-PEG@YD hydrogel (Strain: 0.2%; Frequency: 0.1~100 rad/s)

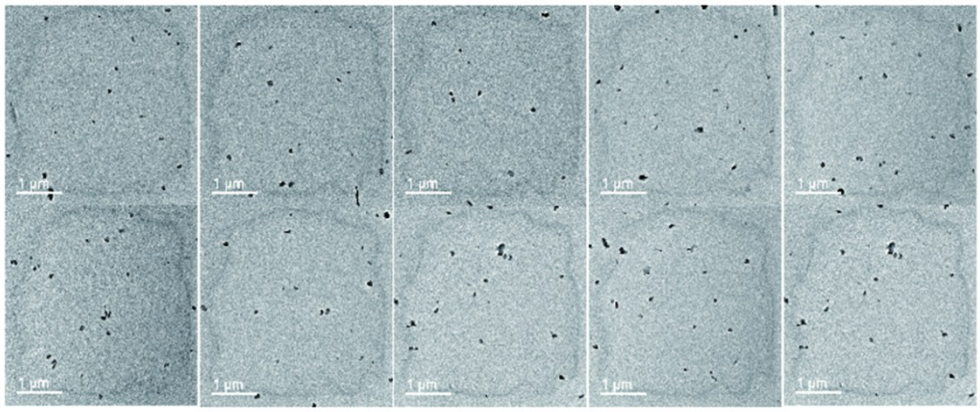


Fig. S6 TEM images of $NbSe_2$-PEG NSs

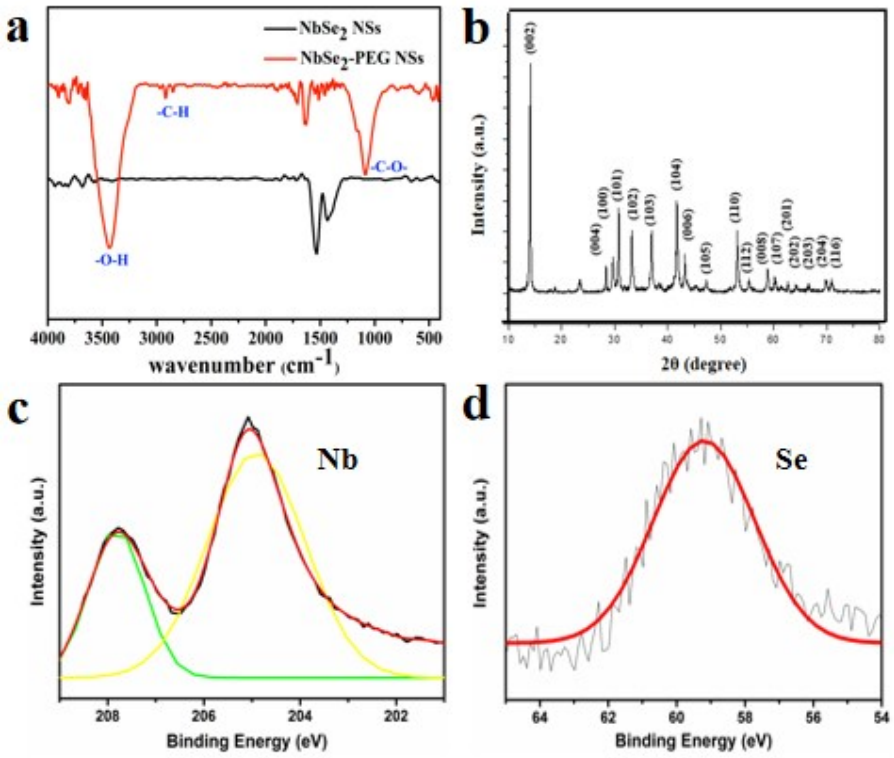


Fig. S7 (a) FTIR spectra of $NbSe_2$ NSs and $NbSe_2$-PEG NSs; (b) XRD spectra of $NbSe_2$-PEG NSs; (c) (d) XPS spectra of $NbSe_2$-PEG NSs

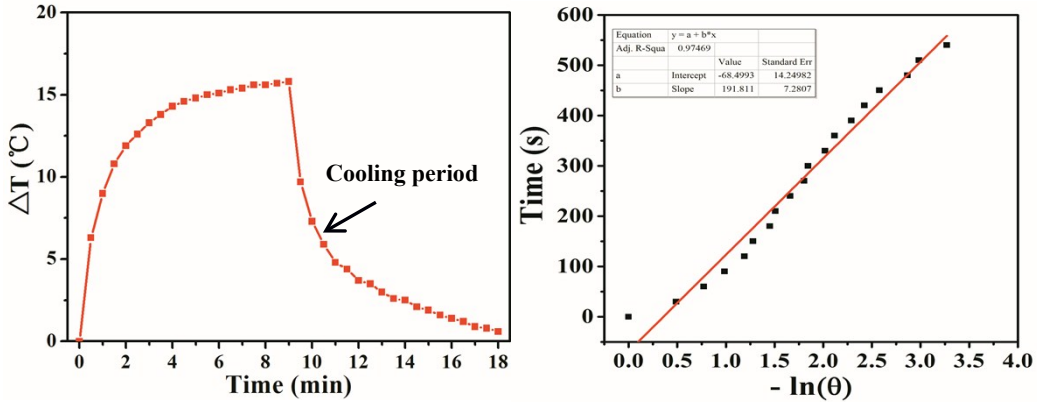


Fig. S8 (a) Photothermal heating curve of the $NbSe_2$-PEG NSs aqueous solution upon 808 nm laser irradiation (2 W/cm^2) and then the laser was turned off; (b) Linear time data versus-ln (θ) obtained from the cooling period of (a).

To measure the photothermal conversion performance of the $NbSe_2$-PEG NSs, 500 μL of the $NbSe_2$-PEG NSs aqueous solution was determined by the follow ing equations:

$\eta = hS(T_{max}-T_{max,water})/I(1-10^{-A808})$

$hS = \sum mC_p/\tau_s$

$\tau_s = -t/\ln\theta$

$\theta = (T_{amb}-T)/(T_{amb}-T_{max})$

In the equations, h is the heat-transfer coefficient, S is the surface area of the

container, T is the real-time temperature, T_{max} is the maximum system temperature, and T_{amb} is the ambient temperature of the surroundings, I is the laser power, A_{808} is the absorbance of the solution at 808 nm. The variable τs is the sample-system time constant, and m and C are the mass and heat capacity of the deionized water used as the solvent.

A_{808}= 0.15442

τ_s= 192 s

hs= 0.5×4.2/192=0.011

$\eta=\{[0.011\times(15.8-2.65)]/2\times(1-10^{-0.15442}\}\times100\%=$ 24.1%

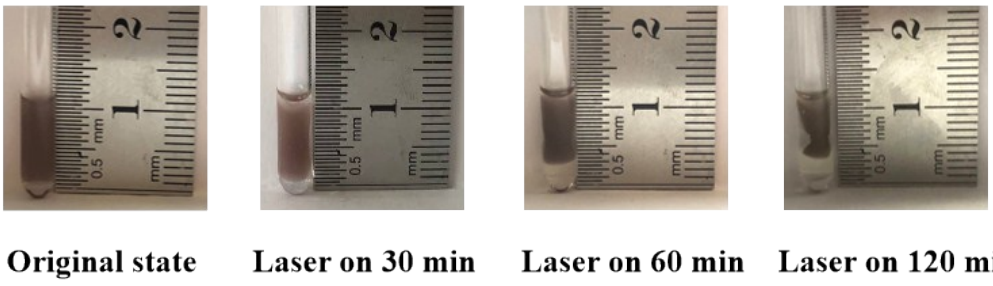


Fig. S9 Optical images of $NbSe_2$-PEG@YD hydrogel after 0 min, 30 min, 60 min and 120 min under NIR irradiation (808 nm, 2 W/cm^2).

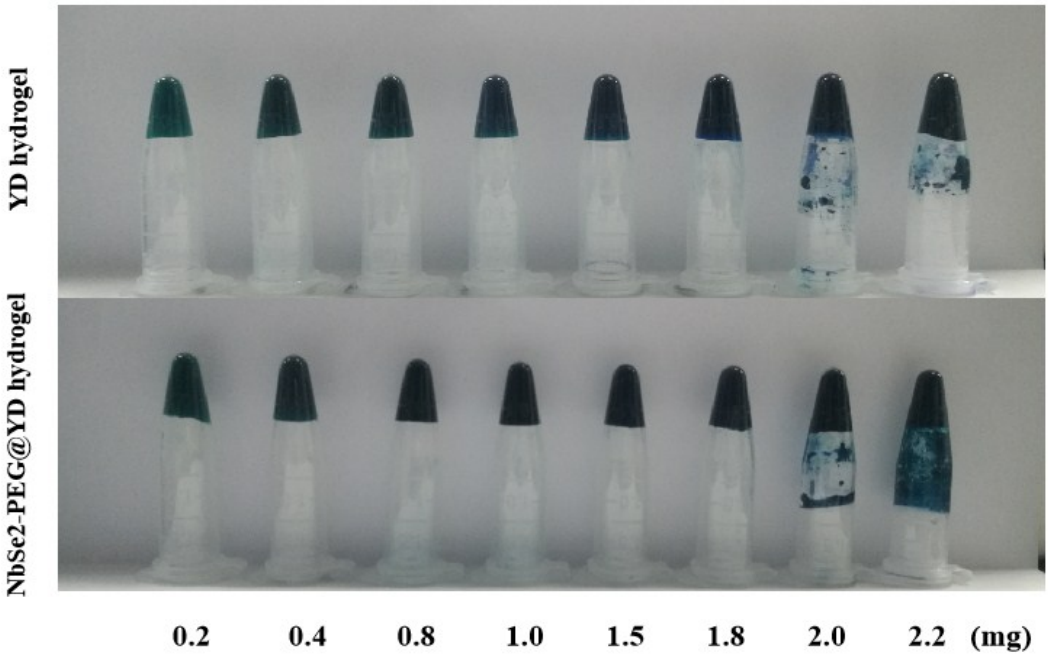


Fig. S10 Images of inverted vials with hydrogels showing gelation and maximum loading capacity. Loading capacity is indicated as the amount of Malachite Green (mg) per 200 μL of 2% (w/v) YD hydrogel and $NbSe_2$-PEG@YD hydrogel.

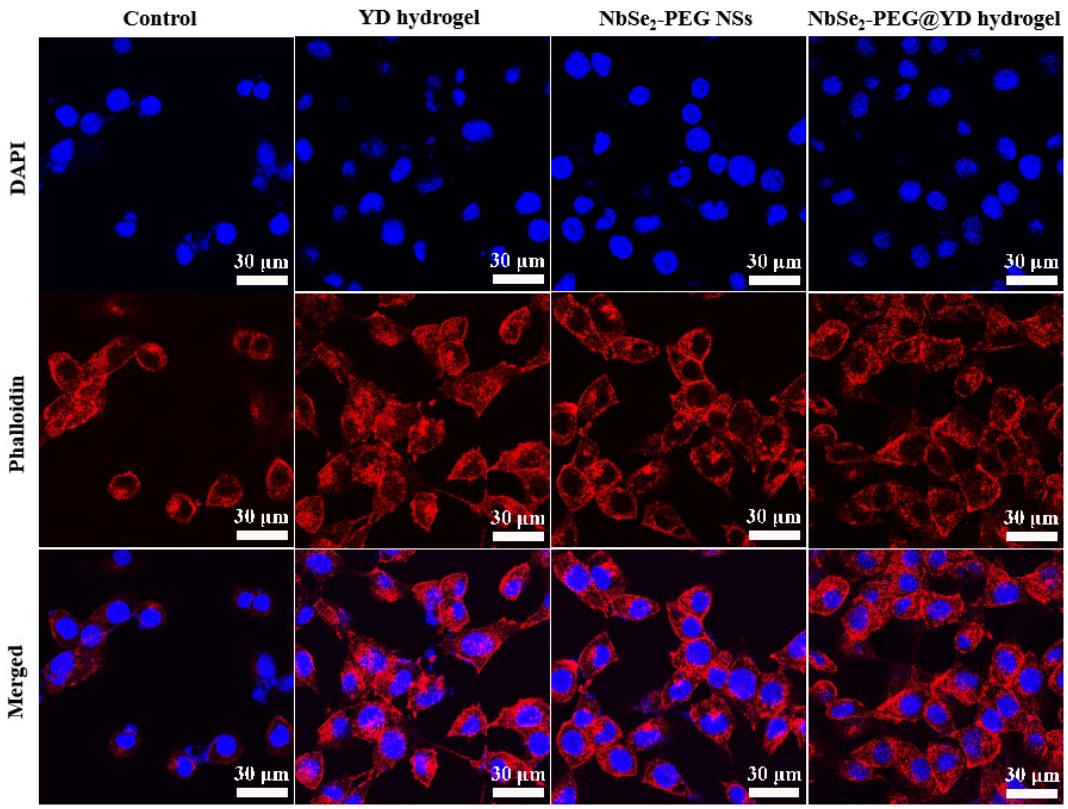


Fig. S11 Confocal images of NIH 3T3 cells stained with DAPI and Alexa Fluor 633 phalloidin after treatment with YD hydrogel, $NbSe_2$-PEG NSs, and $NbSe_2$-PEG@YD hydrogel for 24 h. The fluorescence of DAPI and Alexa Fluor 633 phalloidin are colored as blue and red, respectively.