Supplementary materials

Using near-infrared enhanced thermozyne and scFv dual-conjugated Au nanorods for detection and targeted photothermal treatment of Alzheimer’s disease

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**Figure S1.** Different concentrations of APH and scFv for degradation and/or inhibition Aβ. Fibrillation kinetics of Aβ as monitored by the development of thioflavin T binding in the presence of APH (A) or scFv (B).

**Figure S2.** TEM image of as synthesized GAS.
Figure S3. FTIR spectra of APH ST0779 (a) and GAS (b).

Figure S4. Relative activity of thermophilic APH heated by water bath and photothermal GAS heated by exposure to a 808nm NIR laser at the same temperature. Enzyme activity was tested with Ac-A₃ as the substrate in Tris-HCl buffer (50mmol L⁻¹, pH=8.0). Error bars indicate the standard deviation from three independent experiments.
Figure S5. NIR-induced enzymatic activity of GAS aqueous solution compared with APH at different power densities. APH was heated by water bath to the same temperature as GAS heated by the photothermal effect. The concentration of GAS was 1mg/mL, in which the enzyme loading is equivalent to free APH 0.46mg/mL. Error bars indicate the standard deviation from three independent experiments.

Figure S6. Stability of APH and GAS was measured the retained activity after they had been subjected to proteolytic degradation, suggesting mobilization prevents the protease from degrading the APH. Error bars indicate the standard deviation from three independent experiments.
Figure A: Normalized absorption spectra of control and different concentrations of Aβ fibrils over a wavelength range of 400 to 900 nm.

Figure B: Changes in normalized absorption over time after NIR laser irradiation. The spectrum shows peaks at different wavelengths indicating the effect of Aβ fibrils over time.

Figure C: Graph showing the change in wavelength with time after NIR laser irradiation. The transverse wavelength decreases while the longitudinal wavelength increases with time.
**Figure S7.** Influence of Aβ1-40 aggregates on the absorption spectrum of GAS. (A) Absorption spectrum of GAS in the presence of different concentration of Aβ1-40 fibrils. (B) Recovery of absorption spectrum for the first three days’ samples in the presence of GAS upon NIR laser irradiation. (C) Shift of transverse and longitudinal plasmon bands during the Aβ fibrillogenesis process in the presence of GAS and exposure to NIR laser for the first three days’ samples.

![Fluorescence spectra of ThT in the presence or absence of GNRs.](image)

**Figure S8.** Fluorescence spectra of ThT in the presence or absence of GNRs.

![Inhibitory effect of GAS on Aβ monomers for another two days as monitored by TEM.](image)

**Figure S9.** Inhibitory effect of GAS on Aβ monomers for another two days as monitored by TEM.
**Figure S10.** The sustainable inhibitory effect on Aβ fibrils formation after removal of GAS as monitored by TEM.

**Figure S11.** Western blot assay for testing anti-Aβ ability of GAS. Lane 1: Aβ oligomers incubated with 40ug/ml GAS; Lane 2: Aβ fibrils incubated with 40ug/ml GAS. Lane 3: Aβ monomers incubated with 40ug/ml GAS. Lane 4: Aβ oligomers alone; Lane 5: Aβ fibrils alone. Lane 6: Aβ monomers alone. Each sample containing GAS was exposure to NIR laser irradiation for 5 minutes per day and was observed on the seventh day.
Figure S12. CD spectra of Aβ monomers in the absence or presence of GAS.
Figure S13. HPLC-MS analysis of soluble Aβ1-40 digested by APH. All three samples were incubated simultaneously for 20 hours at 37°C.
Figure S14. Effect of GAS, APH, scFv and the combination of APH and scFv on the inhibition of Aβ induced peroxidase activity, monitoring the increase of the 420nm absorption intensity.

Figure S15. Protein purity of APH ST0779 and scFv 12B4 by Ni-NTA affinity chromatography.