Supplementary information

A novel and highly sensitive gaseous n-hexane sensor based on thermal desorption/cataluminescence

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1. Selection of the adsorbent

As diverse adsorbents showed different adsorptivity to different kinds of vapors, for n-hexane, the uptake of Tenax-TA was better than that of Tenax-GR, Tenax-GC and active carbon (Fig. S1). As we known, Tenax-TA is with good performance of adsorption and desorption capacity to volatile organic compounds (≥C6). Therefore, Tenax-TA was selected as the optimum adsorbent.

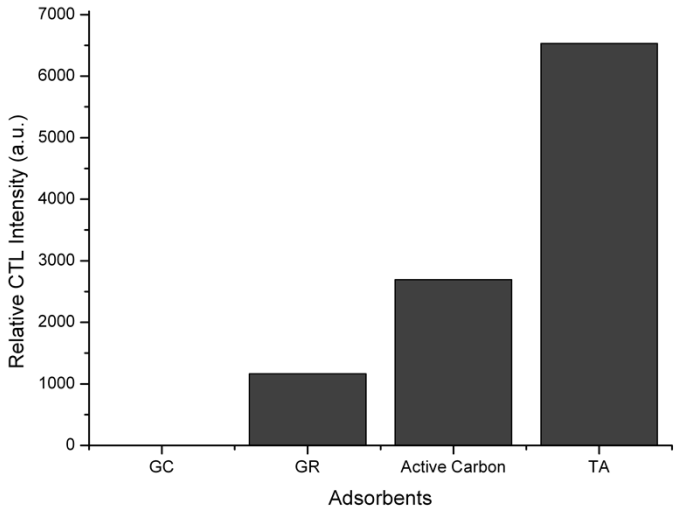

Fig. S1 CTL response of n-hexane gas to different adsorbents (300 mL/min, 400 nm, Tc: 200 ^{o}C, Td: 250 ^{o}C, td: 480 s).

2. Optimization of thermal desorption conditions

The thermal desorption conditions of thermal desorption temperature and thermal desorption time were studied here. As shown in Fig. S2, the relative CTL intensity of 6.59 mg/m^3 n-hexane vapor increased when the

thermal desorption temperature was increasing in the range of 120-250 °C, and the incandescent radiation noise of the substrate was increasing with the temperature increasing. But when the temperature was above 250 °C, the CTL intensity decreased. The reason for it is that when the thermal desorption temperature reached 250 °C, the adsorbed n-hexane in the Tenax-TA was completely desorbed, so when over 250 °C, the relative CTL intensity decreased since the noise rose. Therefore, 250 °C was selected as the optimum thermal desorption temperature.

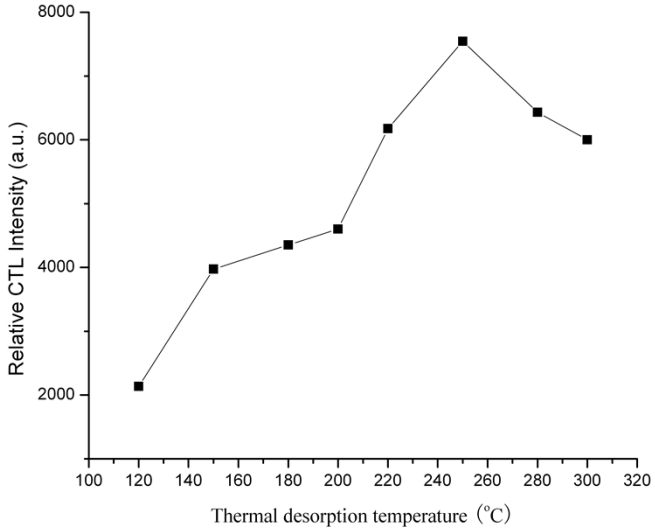

Fig. S2 Thermal desorption temperature dependence of CTL intensity of n-hexane vapor (300 mL/min, 400 nm, Tenax-TA, Tc: 200 °C, td: 480 s).

The thermal desorption time dependence of the CTL intensity was studied ranging from 180 s to 540 s. According to Fig. S3, the CTL intensity increased slightly when thermal desorption time above 480 s. Thus, 480 s was selected as the optimum thermal desorption time.

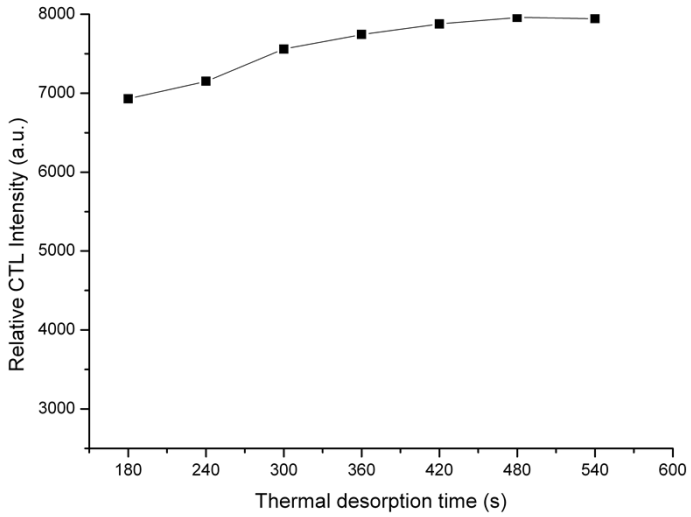

Fig. S3 Thermal desorption time dependence of the CTL intensity (300 mL/min, 400 nm, Tenax-TA, Td: 250 ^{o}C, Tc: 200 ^{o}C).

3. Selection of the wavelength

As the incandescent radiation noise signals at longer wavelength are higher than those at shorter wavelength, the signal-to-noise ratio (S/N) is used to express the real CTL intensity, and it is preferred for quantitative detection owing to the maximal value of S/N and lowest incandescent radiation noise. Fig. S4 presented the CTL spectra of n-hexane vapor at a flow rate of 300 mL/min, catalytic temperature at 200 ^{o}C. Therefore, 400 nm was the optimum wavelength.

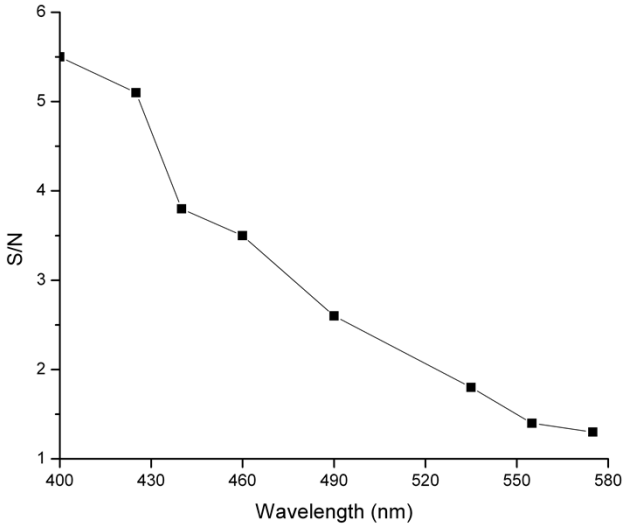

Fig. S4 Wavelength dependence of CTL intensity of n-hexane vapor (300 mL/ min, Tenax-TA, Td: 250 ^{o}C, Tc: 200 ^{o}C, td: 480 s).

4. Optimization of catalytic temperature

Fig. S5 showed the catalytic temperature dependence of the CTL intensity of 6.59 mg/m^3 n-hexane vapor. As shown in Fig. S5, the relative CTL intensity increased when temperature was increasing, but the incandescent radiation noise of the substrate was also increasing. The largest signal-to-noise ratio was obtained at 200 ^{o}C. Therefore, 200 ^{o}C was selected as the optimum detection temperature.

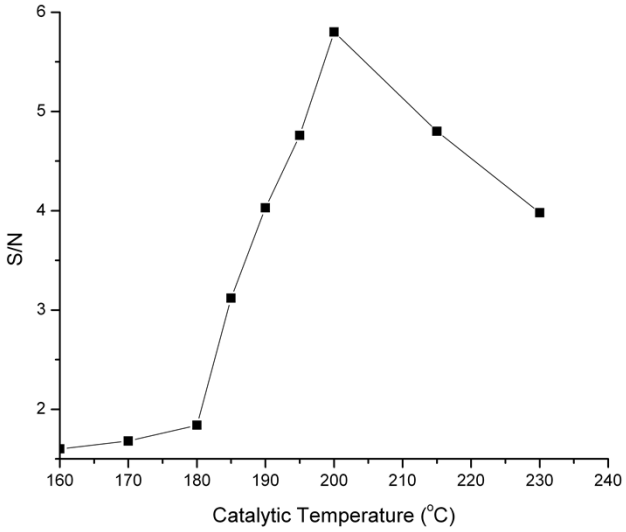

Fig. S5 Catalytic temperature dependence of CTL intensity of n-hexane vapor (300 mL/min, 400 nm, Tenax-TA, Td: 250 °C, td: 480 s).

5. Optimization of air flow rate

The flow rate of carrier air dependence of the CTL intensity was investigated ranging from 30 to 430 mL/min. As showed in Fig. S6, the CTL intensity of 6.59 mg/m^3 n-hexane vapor increased with an increase in the range of 30-300 mL/min. But when the flow rate was above 300 mL/min, the CTL intensity decreased slightly. The reason for it may be that the reaction time between n-hexane and catalyst would not be sufficient when flow rate of carrier gas increased to above 300 mL/min. Thus, a carrier gas flow rate of 300 mL/min was chosen for the detection.

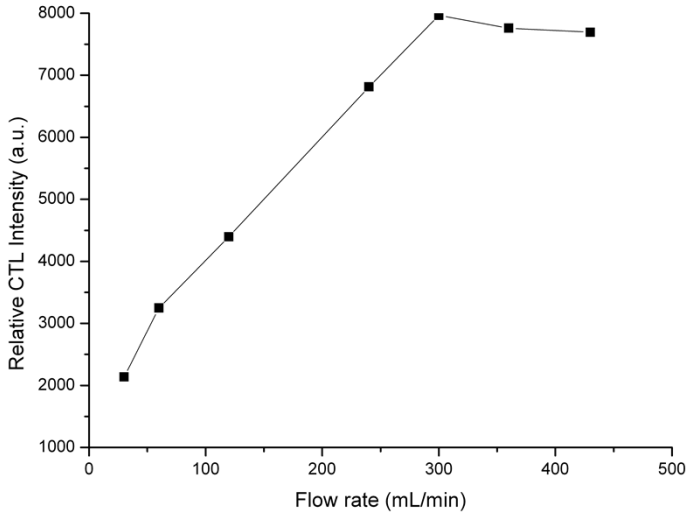

Fig. S6 Air flow rate dependence of CTL intensity of n-hexane vapor (400 nm, Tenax-TA, Td: 250 ^{o}C, Tc: 200 ^{o}C, td: 480 s).