**Supporting information for**

# A novel nickel trap coupled with electrothermal vaporization for direct solid sampling analysis of cadmium in soil

Tengpeng Liu,[a] Jixin Liu,[*,a,b] Xuefei Mao,[*a] Xing Na,[b] Yunbin Shao,[b] Yongzhong Qian[a]

[a]*Institute of Quality Standard and Testing Technology for Agro-products, Chinese Academy of Agricultural Sciences, and Key Laboratory of Agro-food Safety and Quality, Ministry of Agriculture and Rural Affairs, Beijing 100081, China*

[b]*Beijing Ability Technology Company, Limited, Beijing 100081, China*

Corresponding authors: Tel: +86-10-82106523, Fax: +86-10-82106523.

E-mail address: mxf08@163.com & maoxuefei@caas.cn (X. F. Mao); ljx2117@gmail.com (J. X. Liu)

## 1. The Programs of Solid Sampling Device.

**Table S1 Program of the ETV apparatus.**

| ETV program | Power (W) | Measured temperature (°C) | Time (s) | Signal acquisition |
|---|---|---|---|---|
| Drying | 25 | 120 | 30 | No |
| Ashing | 100 | 500 | 60 | No |
| Vaporization/trapping | 130 | 900 | 30 | Yes |
| Releasing | 105 | 1000 | 30 | Yes |
| Cooling | 0 | 25 | 30 | Yes |
| Cleaning | 120 | 1200 | 20 | No |

## 2. The operational parameters of ICP-MS

**Table S2 Instrumental conditions of ICP-MS**

| Parameters | Values |
|---|---|
| Incident RF power (W) | 1350 |
| Cooling Ar flow rate (L/min) | 1.4 |
| Nebulizer Ar flow rate (L/min) | 0.9 |
| Auxiliary Ar flow rate (L/min) | 0.8 |
| Peristaltic pump (rpm) | 30 |
| Cd isotope | $^{111}Cd$ |

## 3. The trapping/releasing capability of TC and NT trap.

The TC was the same with that in the previous study[38], namely a Φ 2.5× 8 mm ten-circle tungsten coil. The coil was linked to a power supply by two tungsten electrodes, and the resistance of the TC is 1.2 Ω.

**Table S3 The peak parameters of NT and TC trap**

| Trap | | TC | NT |
|---|---|---|---|
| Breakthrough peak | Breakthrough peak areas | $2.20\times10^4$ | - |
| | Half peak width | 10.62 | - |
| | Peak height | 1393 | - |
| Releasing peak | Releasing peak areas | 6333 | $2.89\times10^4$ |
| | Half peak width | 2.49 | 3.92 |
| | Peak height | 2446 | 5821 |

## 4. The releasing time of NT tube

The 10 μL Cd standard solutions (100 μg/L) were introduced at 105 W under different NT releasing times (21-36 s). As shown in **Figure S1**, the shorter time causes that Cd cannot be released completely; with the increase of releasing time, the Cd intensity increases, and then enters a plateau after 30 s with a better stability (RSD < 5%). Therefore, considering the effects of Cd releasing power and time, 30 s was chosen as the optimal conditions of NT tube.

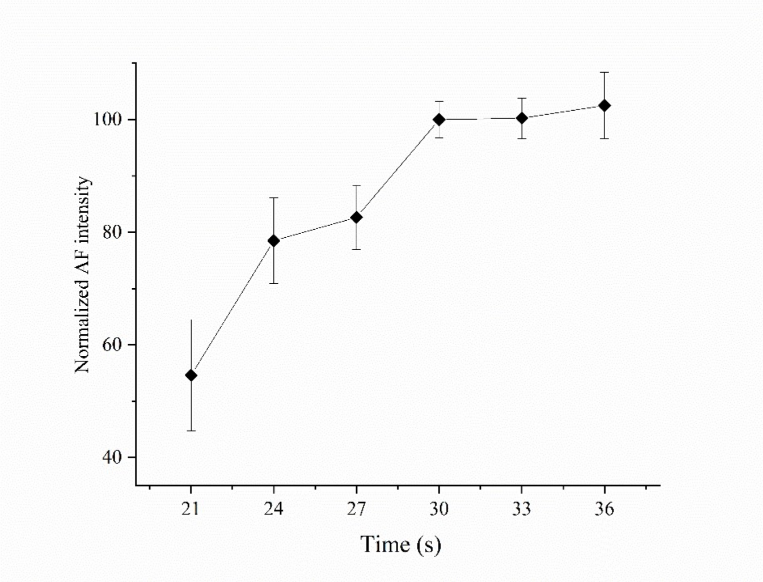


**Figure S1. Effect of releasing time for Cd releasing (n = 3)**. The NT releasing power is 105 W, and AFS intensity is normalized with signal at 30 s set as 100.

**5. The effect of shielding gas.**

The 10 μL Cd standard solutions (100 μg/L) were introduced under different shielding gas flow rates. Cd signals went up with shielding gas flow increase; and the signal reached the highest under 600 mL/min, then declined possibly due to the dilution effect. Therefore, 600 mL/min was chosen as the optimal shielding gas flow rate.

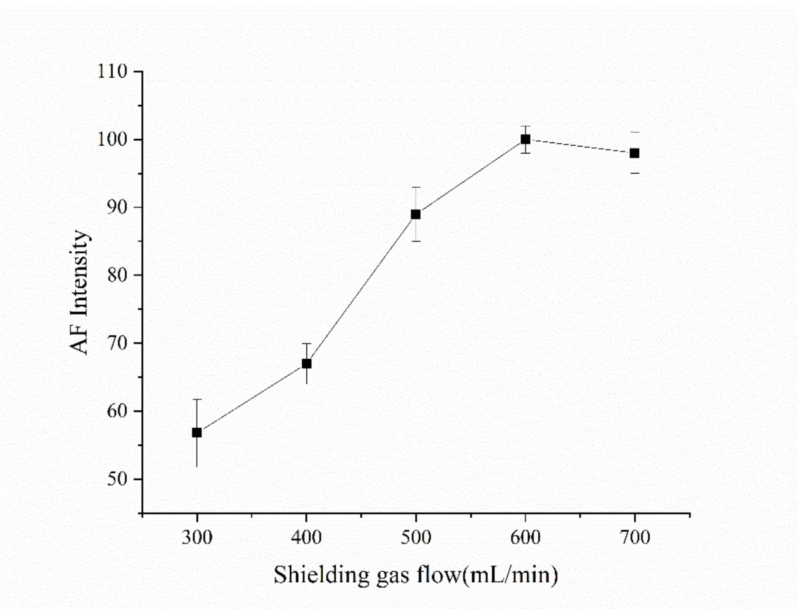


**Figure S2. Effect of shielding gas flow rate on Cd signals (n = 3)**. The NT releasing power and time is 105 W (30 s), and AFS intensity is normalized with the signal at 600 mL/min set as 100.

**6. The AF signals of Cd without or with NT.**

The Cd vaporization signals without NT trapping indicated unsymmetrical and tailed peaks, which were negative to precise quantification. For another, the Cd signals and peak paraments of soil samples with and without NT were shown in **Figure S3**, the Cd peak width at half height with NT is obviously narrower than that without; as well, the Cd peak shape with NT is sharper and more symmetric. So, the enhancement effect of Cd sensitivity can be reached *via* the trap and release (preconcentration) process by NT.

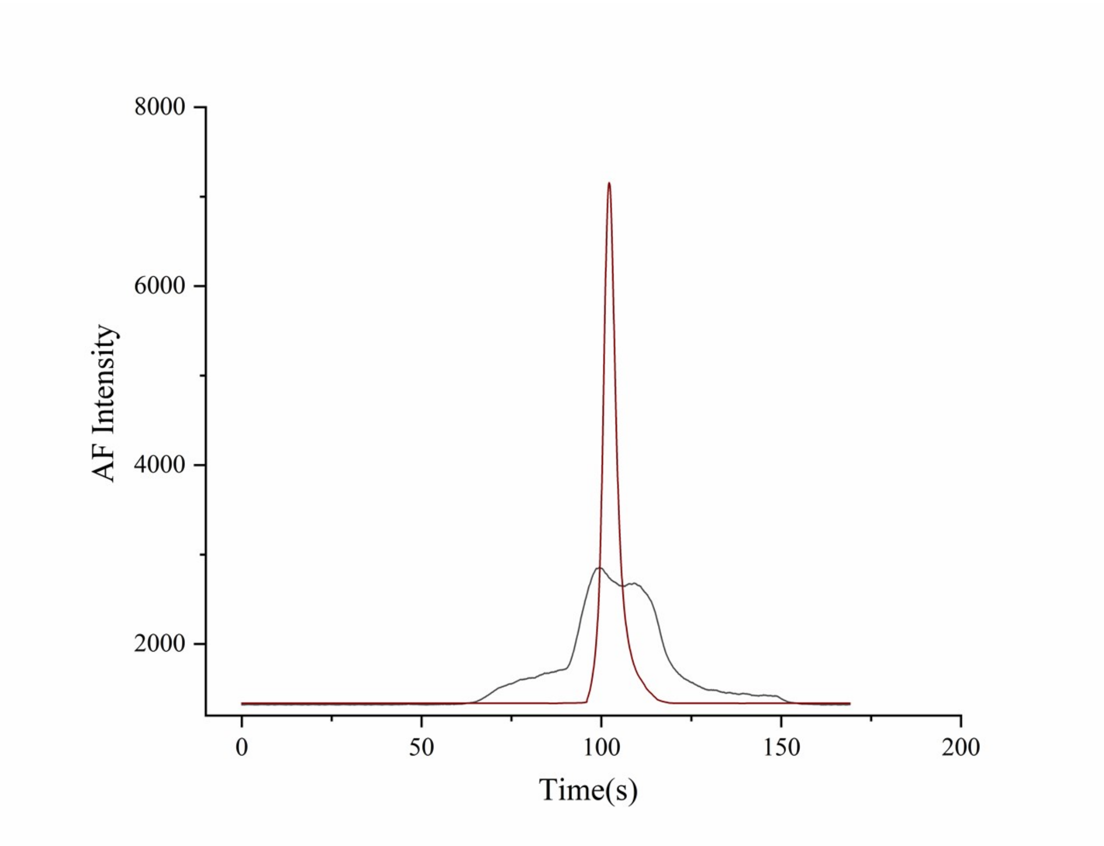


**Figure S3. The AF signals of Cd without or with NT**. Black line, 20 mg soil was introduced into the solid sampling system without NT. Red line, 20 mg soil was introduced into the solid sampling system with NT, and then released at the optimized conditions. Herein, the half peak widths without and with NT are 3.92 and 23, respectively: the peak heights without and with NT are 5819 and 1533, respectively; the peak areas without and with NT are $4.52\times10^4$ and $2.87\times10^4$, respectively.