Supporting Information (SI)

Immobilization of Mercury by Nano-elemental Selenium and the underlying Mechanisms in Hydroponic-cultured Garlic Plant

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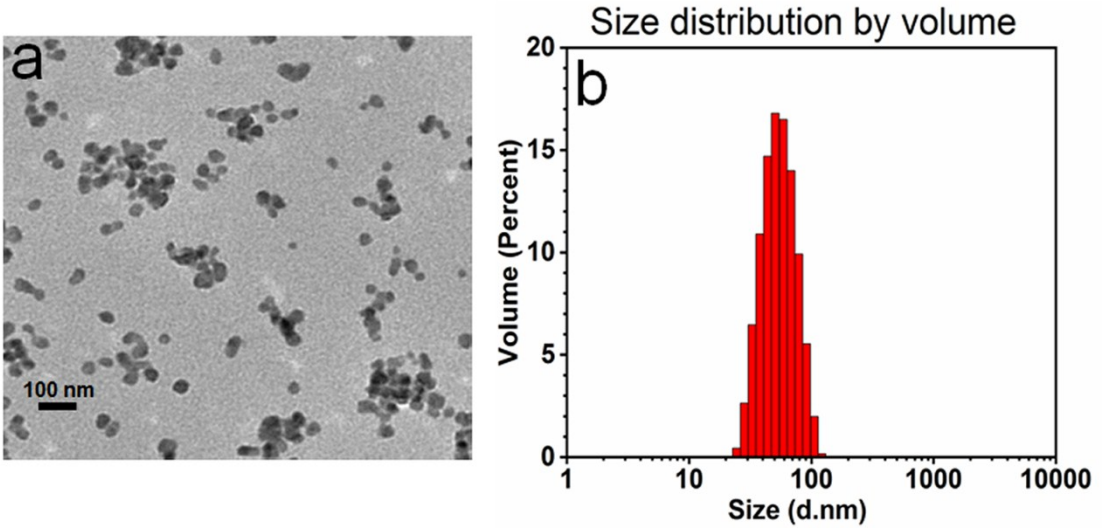
The supporting information file contains 4 figures and 1 table.

Characterization of SeNPs

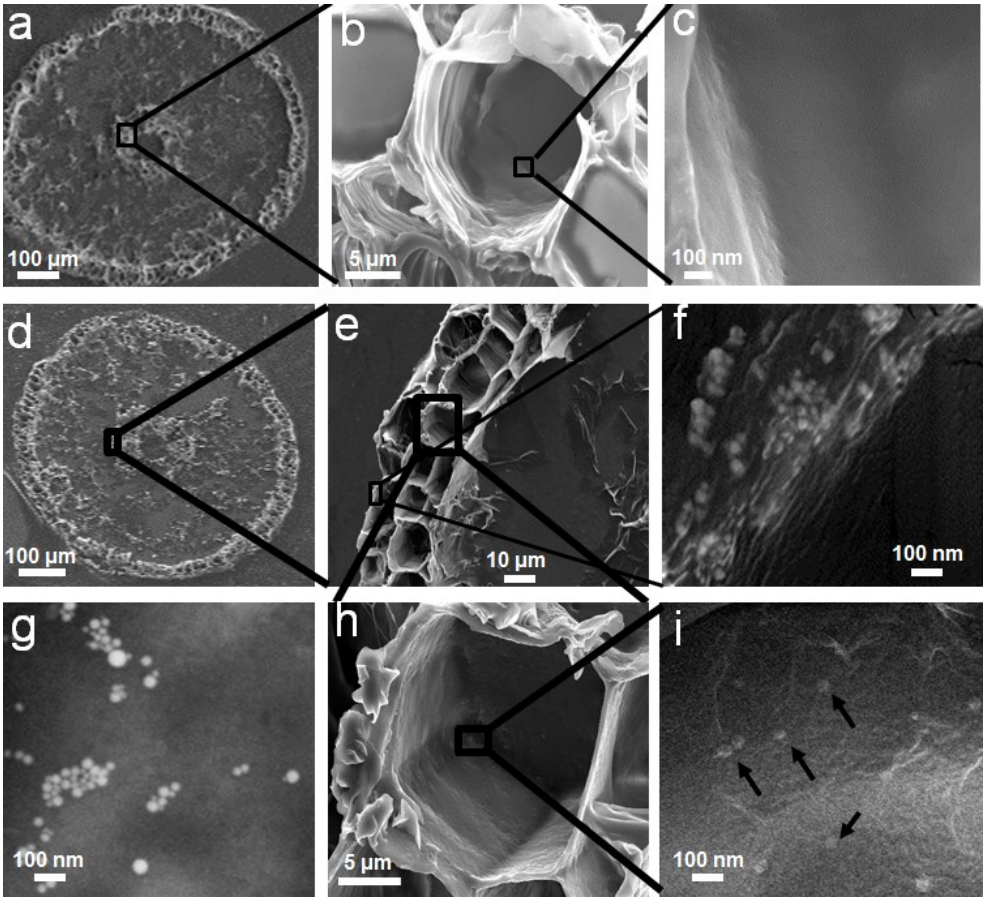
Figure S1 The morphologies of the applied SeNPs characterized by Transmission Electron Microscope (TEM, Figure S1-a). The hydrodynamic size of SeNPs in water analyzed by dynamic light scattering (DLS, Figure S1-b).



SEM evidence for SeNPs entering into the root vein tissues

To further confirm the distribution of SeNPs in plant root, the SEM imaging of SeNPs distribution in root tissues was carried out. The roots were thoroughly washed by deionized water, and then cut into cross sections. These sections were observed by SEM. The imaging were shown in figure S1. These SEM imaging provided the visual evidence of SeNPs entering into the vascular tissues of the plant root.

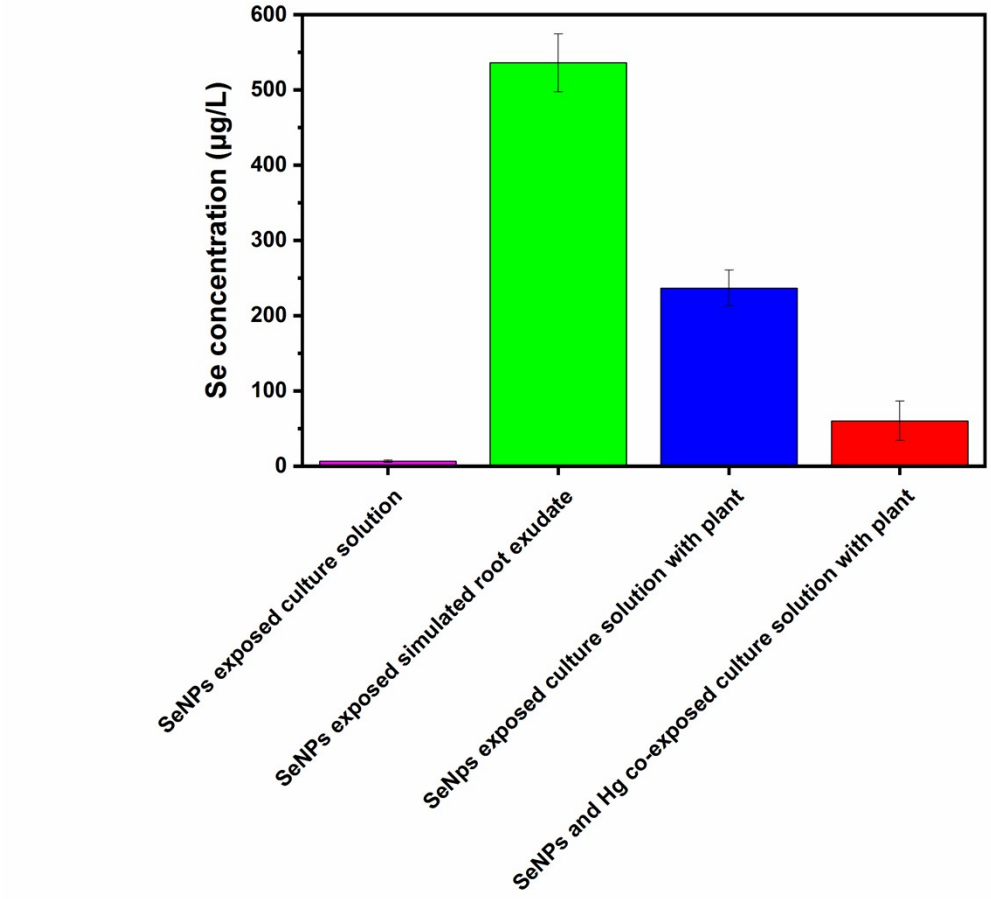
Figure S2 SEM images of the control (without SeNPs exposure), and SeNPs exposed root. a), b) and c) show the SEM images of the control root. e) and f) show the SeNPs in the root epidermis. h) and i) show the SeNPs in the vascular tissues of the root. Figure g) shows the SEM image of SeNPs in water before used.


a
100 µm
b
5 µm
c
100 nm
d
100 µm
e
10 µm
f
100 nm
g
100 nm
h
5 µm
i
100 nm

Compared studies on the dissolution of SeNPs by root exudates

To evaluate the impact of root exudates on free Se release from SeNPs, four reaction solutions, which were separately composed of culture solution, 1 mM KH_2PO_4 + citric acid + ascorbic acid, culture solution with plant growing, and Hg exposed culture solution with plant growing, were prepared and compared. The pH values were adjusted to 5.5 which were similar with that of the nutrient solution. SeNPs were added to the solutions with stirring action. The original concentrations of SeNPs in all the groups were 50 mg/L. After a four weeks static incubation, the suspensions of all treatments were centrifuged and collected. The total Se concentrations in all centrifuged suspensions were quantified with ICP-MS, and shown in figure S2.

Figure S3 Concentrations of Se in the collected suspensions of the SeNPs exposed culture solution (control, pink), SeNPs exposed simulated root exudate (green), SeNPs exposed culture solution with plant growing (blue), and SeNPs and Hg co-exposed culture solution with plant growing after four weeks of incubation.



Confirmation of the existence of HgSe particles in the precipitate of Hg and SeNPs co-exposed solution by SR-XANES

The final precipitate in Hg and SeNPs co-exposed solution was collected at the end stage of plant cultivation, and then measured by SR-XANES. The SR-XANES of Hg in the precipitate, as well as in the six standard Hg-containing compounds were shown in figure S3. The Hg SR-XANES data demonstrated that HgSe was the dominant Hg species in the collected precipitate of the Hg and SeNPs co-exposed culture solution.

Figure S4 figure a) shows the SEM image of the re-suspended precipitate in the Hg and SeNPs co-exposed group at the end stage of plant culture. Figure b) shows the XANES results for Hg species in the collected precipitate, as well as the XANES spectra of six Hg standard compounds. It showed that HgSe was the dominant Hg species in the precipitate.

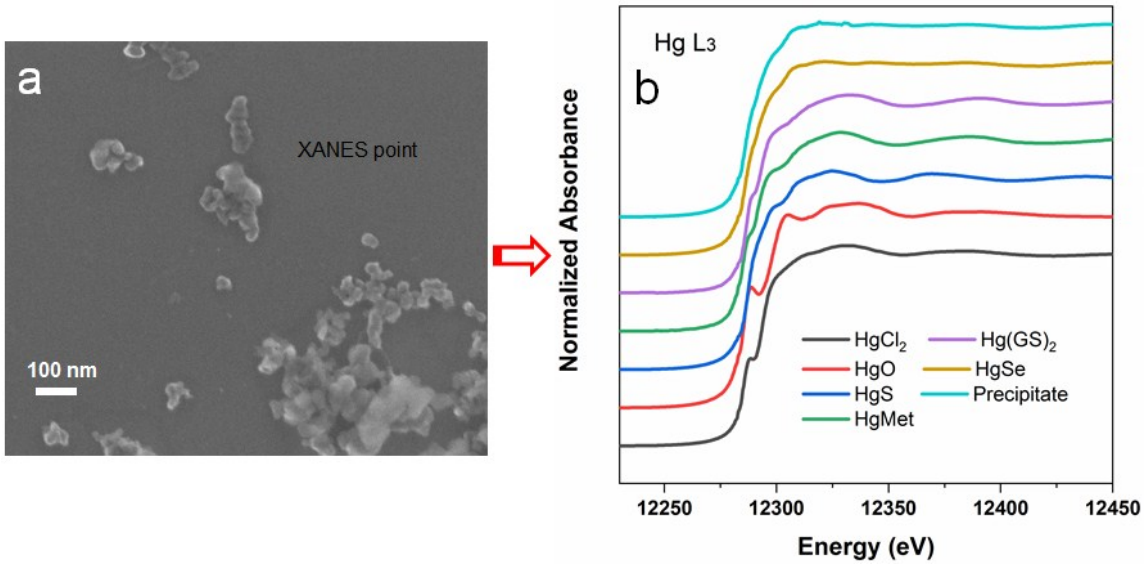


Table S1 The experiment sets of the Hg and Se exposed plants, gray areas are for the samples.

Hg^{2+} (mg Hg L^{-1} from $HgCl_2$)	Samples	Se treatment dose (mg Se L^{-1} from SeNPs, selenite, and selenate, respectively)					
		0	0.01	0.1	1	10	50
0	Root						
	Stem						
	leaf						
0.01	Root						
	Stem						
	leaf						
1	Root						
	Stem						
	leaf						
50	Root						
	Stem						
	leaf						