Electronic Supplementary Information

Hydroxyapatite nanoparticles in root cell: reducing the mobility and toxicity of Pb in rice

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Figure S1. The Ca concentrations after 5-day periods in the nutrient solution. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S2. Dry weight and root length of rice after 5-d treatments. CK is the control treatment without the addition of nHAP or mHAP. nHAP and mHAP treatments are the nutrient solution containing 100 mg L⁻¹ nHAP or mHAP, respectively. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different times at P < 0.05 (LSD test).



Figure S3. TEM observations of nHAP aggregates in the rice root. (a) the ultrathin slices of rice root in nHAP treatment after 5 days, (b) The magnifications of the area delimited by the white squares in image (a), Element (O, Ca, P) mapping shown in the bottom panels are collected from the white squares in image (a). For the photos: CM) cell membrane, CW) cell wall.



Figure S4. Ca (g kg⁻¹) and Pb (mg kg⁻¹) concentrations remaining in rice roots after the treatment with HNO₃ and HAc dissolution solution for different times respectively. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different times at P < 0.05 (LSD test).



Figure S5. HAPs uptake by rice after 5-day treatments. (a) Ca concentrations of root and shoot in nutrient solution, (b) Ca concentrations of root and shoot in nutrient solution without the component of Ca(NO₃)₂. Ca concentrations in root was measured after the desorption step to remove surface adsorbed HAPs in roots. CK, Ca, mHAP and nHAP represent control, 1 mg L⁻¹ Ca ions, 100 mg L⁻¹ nHAP and 100 mg L⁻¹ mHAP treatments, respectively. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S6. The total Pb amounts found in the root after 14-day exposure to Pb. Control, L-Pb, and H-Pb represent the Pb concentration of 0, 15 and 25 μ M without the HAPs treatments. L-Pb(nHAP) and H-Pb(nHAP) represent nHAP-treated seedling in the Pb concentration of 15 and 25 μ M. H-Pb(mHAP) is mHAP-treated seedling in the Pb concentration of 25 μ M. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S7. Shoot and root length of rice after 14-day exposure to Pb. Control, L-Pb, and H-Pb represent the Pb concentration of 0, 15 and 25 μ M without the HAPs treatments. L-Pb(nHAP) and H-Pb(nHAP) represent nHAP-treated seedling in the Pb concentration of 15 and 25 μ M. H-Pb(mHAP) is mHAP-treated seedling in the Pb concentration of 25 μ M. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S8. Dry weight of root and shoot biomass of rice after 14-day exposure to Pb. Control, L-Pb, and H-Pb represent the Pb concentration of 0, 15 and 25 μ M without the HAPs treatments. L-Pb(nHAP) and H-Pb(nHAP) represent nHAP-treated seedling in the Pb concentration of 15 and 25 μ M. H-Pb(mHAP) is mHAP-treated seedling in the Pb concentration of 25 μ M. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S9. The amounts of Ca desorbed from the root surface in different treatments. CK, Ca, mHAP and nHAP represent control, 1 mg L⁻¹ Ca ions, 100 mg L⁻¹ nHAP and 100 mg L⁻¹ mHAP treatments, respectively. Bars indicate standard deviations (n = 3). Columns with different letters indicate significant variation in different treatments at P < 0.05 (LSD test).



Figure S10. SEM micrographs of cross section of rice root in H-Pb-nHAP treatment. Element mapping are collected from the white squares in SEM image.



Figure S11. SEM micrographs of cross section of rice root in H-Pb treatment. Element mapping are collected from the white squares in SEM image.