Direct Monitoring of Chemical Transformations by Combining Thin Layer Chromatography with Nanoparticle-assisted Laser Desorption/Ionization Mass Spectrometry

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Supporting Information

Text List

Graphic List

1. Spiked Cholesterol in human serum analyzed by DMTM

Cholesterol dissolved with ddH_2O or MeOH, relatively, then mixed with serum for DMTM. Comparison of direct detected and separated via TLC by developing with solvent systems (MeOH/DCM = 1: 9) as mobile phases. Then the separated cholesterol can be positioned by a pencil under chemical staining which provide the corresponding position on another TLC plate for DMTM analysis.

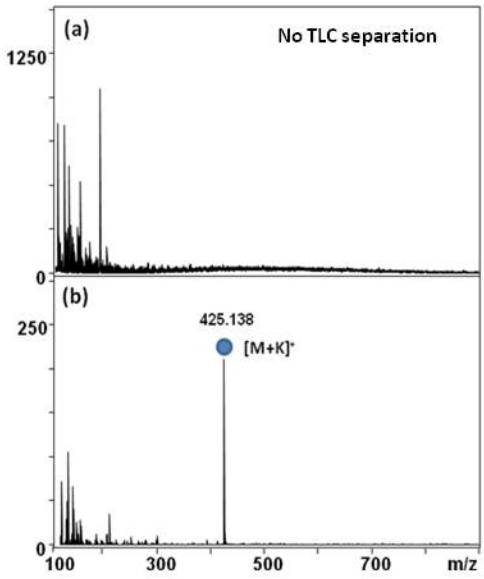


Figure S1. Mass spectra for cholesterol spiked in serum analysis by DMTM (a) measured without TLC separation (b) measured with complete DMTM process.

Figure S2. TLC plates for spiked cholesterol in serum separated by mobile phase and stained with (a) anisaldehyde (b) $KMnO_4$ (c) marked spot mixed with DHB@MNP for DMTM.

2. Sensitivity of DMTM in the detection of cholesterol spiked in serum

The limits of detection (LODs) for cholesterol (initial amount was 1 μg) was determined by preparing a series of dilution with MeOH and spiked in serum. Then diluted cholesterol was mixed with serum by ratio 1:1 for total volume 2 μL. The mixture dropped with capillary tube on the starting position of TLC, developed with solvent systems (MeOH/DCM = 1: 9) as mobile phases. The DHB@MNP solution of 1000 ppm was then deposited onto the spot areas of interest using a micropipette, and immediately air dried after each droplet. Then, the corresponding mass spectra were acquired by the method as mentioned above.

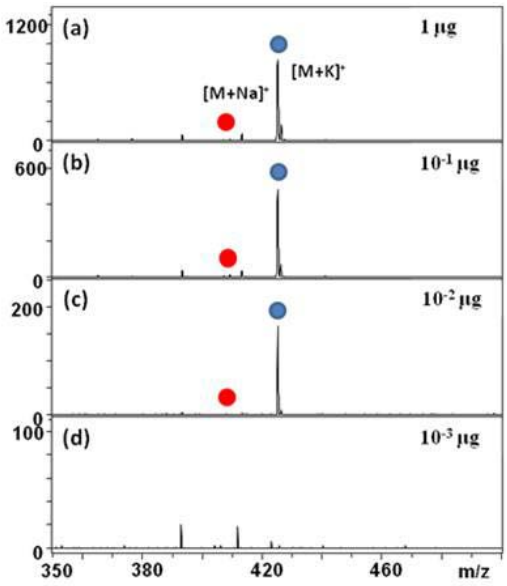
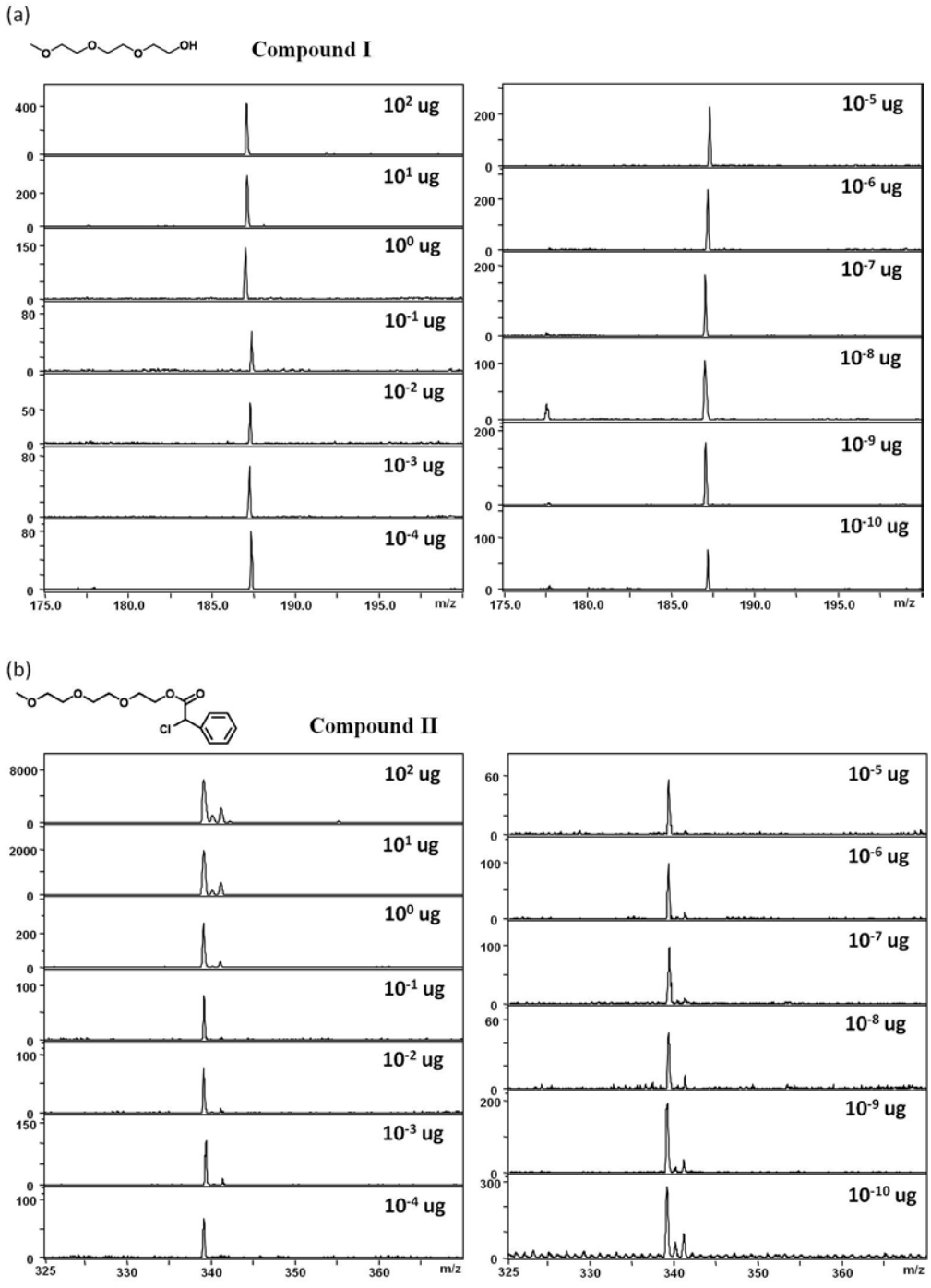
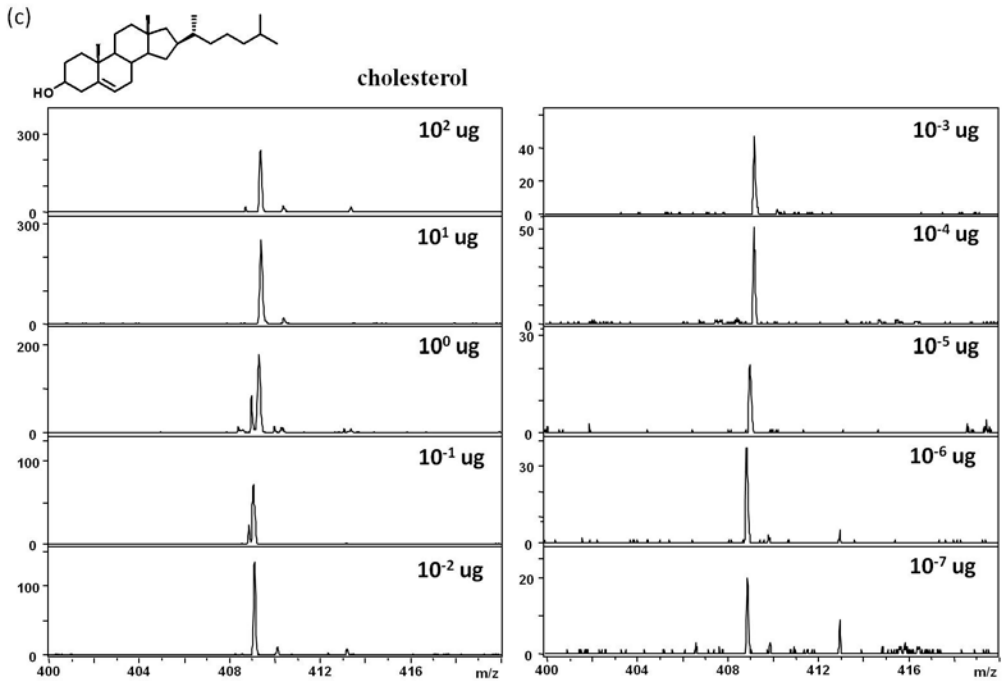
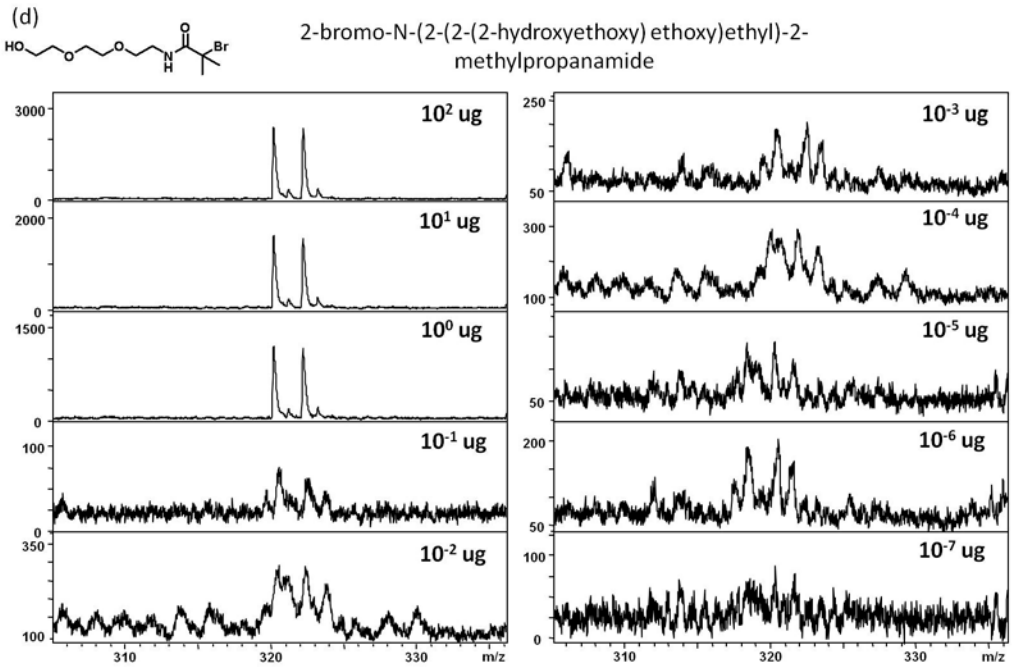


Figure S3. Mass spectra of spiked cholesterol (1-10^{-3} μg) in serum obtained by DMTM. (The red circle markers indicate the molecular weight of sodium adducted [m/z 409.2] and blue circle markers indicate the molecular weight of potassium adducted cholesterol [m/z 425.3].)

3. Sensitivity of DMTM in the identification of various compounds







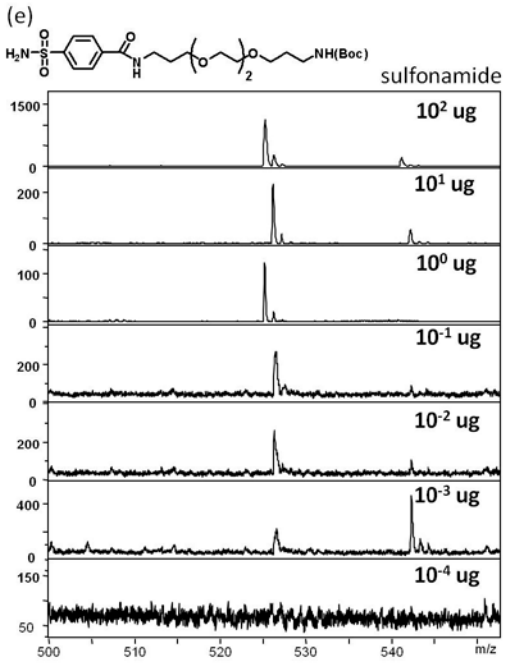


Figure S4. Sensitivity of DMTM in the identification of compounds in Table 1

4. Control experiments of DMTM in monitoring of chemical reaction 1

The chemical reaction 1 was conducted and monitoring by DMTM. Two spectrum of control experiments have been included in the Figure 2a and 2d to give no peaks on the TLC chip in the absence of any matrix. The spectra 2b and 2e gives the data in the presence of DHB molecules. Here, more control experiments are shown in Figure S5. The spectrum (a) gives the background of the bare TLC chip. The spectrum (b) and (c) show the background of DHB molecule and DHB@MNP on the TLC chip.

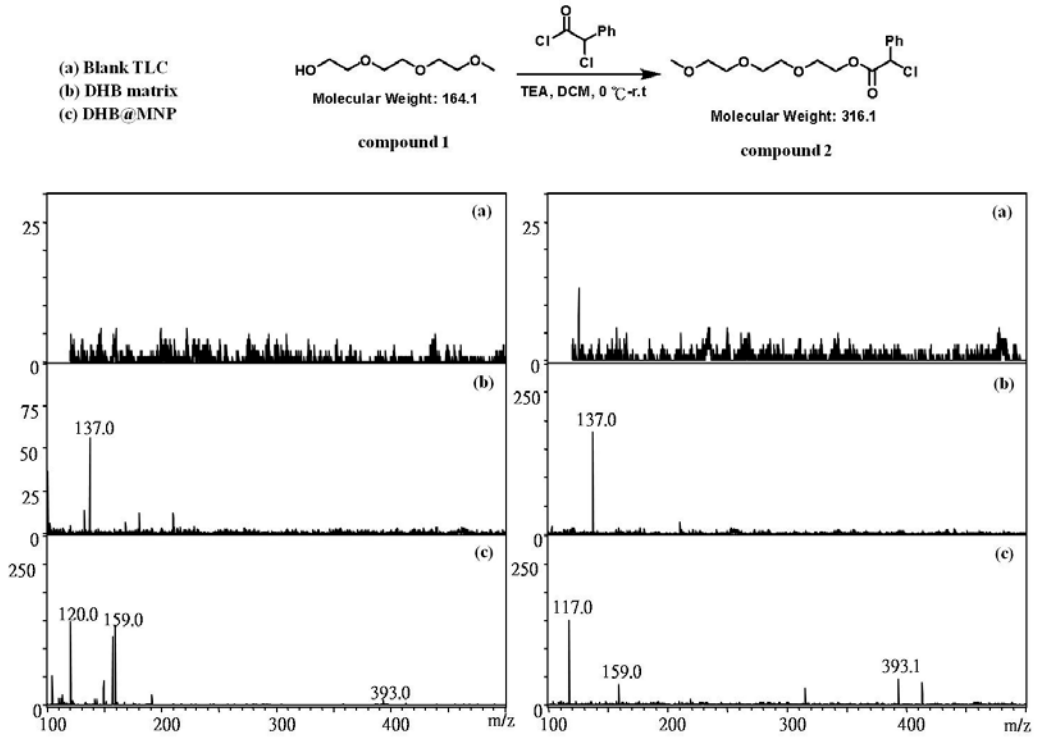


Figure S5. The mass spectra of control experiments of DMTM in monitoring of reaction 1.

5. Optimization of the concentration of DHB@MNP in DMTM

A series dilution of DHB@MNP aqueous solution from 4000 ppm to 100 ppm were prepared and used in the comparison of resulted signal intensity for compound (A) and (B).

Sample preparation: a mixture containing 20 mg/mL of compound (A) (or (B)) (about 6×10^{-2} M) resolved in methanol solution, then mixed with series dilution of DHB@MNP aqueous solution to be analyzed by DMTM. For each bar chart**,** Two hundred and fifty

single-laser shots presented at a 10 Hz frequency were averaged for each mass spectrum and illustrated by bar chart. These error bars were calculated from the variability across the 250 laser shots.

6. Substrate dependent extraction by different solvents

The DHB@MNP was prepared in the concentration of 1000 ppm with various solvents including polar protic solvents (water, and methanol) and relatively low polar aprotic solvents (acetonitrile and 1,4-dioxane).

Sample preparation：a mixture containing 20 mg/mL of compound (A) (or (B)) resolved in methanol solution, and then mixed with prepared various solvents of DHB@MNP 1000 ppm onto the silica surface of the aluminous TLC plate and air dried.

7. Kinetic monitoring of reaction 1

For each data point, three parallel experiments have carried out by taking 10 μL of reaction mixtures and added 2 μL ddH_2O to quench the reaction. Then, 1 μL of the organic phase was spotted on the starting position of a TLC plate, and then developed with solvent systems (EA/Hex = 1:1) as mobile phases. The DHB@MNP solution of 1000 ppm was then deposited onto the spot areas of interest using a micropipette, and immediately air dried after each droplet. Then, the corresponding mass spectra were acquired by the method as mentioned above.

8. Identification of two basic amines by DMTM

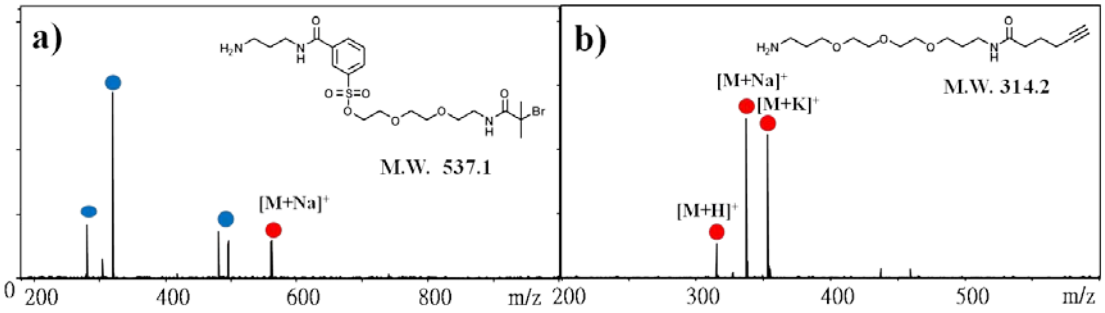


Figure S6. Identification of two amine compounds S6(a) and S6(b). The red circle markers indicate the molecular weight of $[M+Na]^+$ = m/z 560.1 and blue circle markers indicate the fragments with compound S6(a). The red circle markers indicate the molecular weight of $[M+H]^+$ = m/z 315.1; $[M+Na]^+$ = m/z 337.1;$[M+H]^+$ = m/z 353.0 with compound S6(b).