Figure S1. The SIMS depth profile of parent C$_{10}$H$_9$O$_4$+ ([M + H]$^+$) at m/z 193 generated with 16 kV Ar$_{1000}^+$ sputtering and various O$_2^+$ cosputtering.
Figure S2. The steady-state ion intensity (normalized with respect to the intensity on pristine surface) of [M+H]⁺ after GCIB-O₂⁺ cosputtering with various parameters versus the sputter rate. The shade of each color (light/normal/dark) represents the usage of 10/15/20 keV GCIB, respectively.
Figure S3. Zero-force AFM images of surfaces sputtered by single GCIB sputtering at fluence of $1.09 \times 10^{16}$ ion/cm$^2$. Field of view: 5 µm × 5 µm.
Figure S4. Zero-force AFM of surfaces cosputtered by 200 V, 5 µA/cm² O₂⁺ with GCIB fluence of $1.09 \times 10^{16}$ ion/cm². Field of view: 5 µm × 5 µm.
**Figure S5.** Zero-force AFM images of surfaces cosputtered by 500 V, 5 µA/cm² O₂⁺ with GCIB fluence of $1.09 \times 10^{16}$ ion/cm². Field of view: 5 µm × 5 µm.
**Figure S6.** Zero-force AFM images of surfaces cosputtered by 200 V, 80 µA/cm² O₂⁺ with GCIB fluence of 1.09 × 10¹⁶ ion/cm². Field of view: 5 µm × 5 µm.
Figure S7. The steady-state ion intensity (normalized with respect to the intensity on pristine surface) of [M+H]^+ versus the surface roughness after GCIB-O$_2^+$ cosputtering with various parameters. The shade of each color (light/normal/dark) represents the usage of 10/15/20 keV GCIB, respectively.
Table S1. Sputter rate, relative intensity, Young’s modulus and RMS roughness measured with various beam parameters.

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