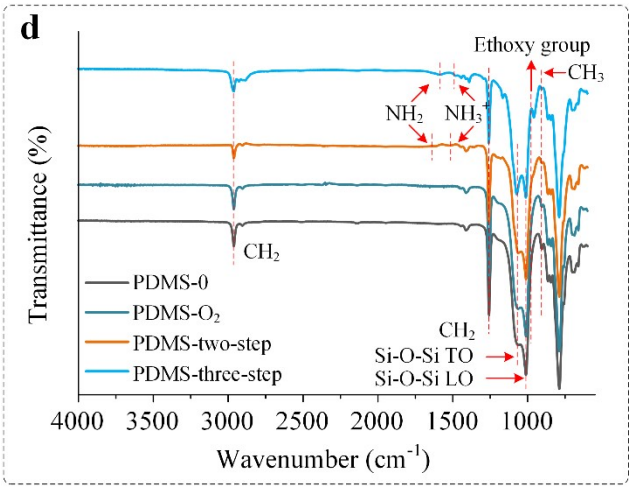
1 FTIR

FTIR was used to analyze the chemical features of the PDMS. Figure. S1d showed the absorption spectra for PDMS-0, PDMS-O_2, PDMS-two-step, and PDMS-three-step, respectively. The peak of stretching vibration of the Si-O-Si longitudinal optical and transverse optical bond was observed at 1010 cm^{-1} to 1342 cm^{-1}. The characteristic peak was assigned to CH_2 (1265 cm^{-1}), and there was a CH_3 peak at 890 cm^{-1} and symmetric stretched vibrations at 2958 cm^{-1}. The methyl group is mainly contributed by the PDMS, which can convert a hydrophilic silica surface to a hydrophobic surface. There were similar FTIR spectra in PDMS-0 and PDMS-O_2. The FTIR of the PDMS-two-step and PDMS-three-step was observed in a broad Si-O-Si band, ranging from 973 cm^{-1} to 1132 cm^{-1}, and SiO_2 LO and TO modes, located at 1062 cm^{-1} and 1012 cm^{-1}. It was worth noting that there were characteristic bands of NH_2, NH_3, CH_2 rocking vibration, and ethoxy group at 1619 cm^{-1}, 1523 cm^{-1}, 1257 cm^{-1}, and 971 cm^{-1} on the surface of PDMS-two-step and PDMS-three-step, indicating successful grafting of APTES onto the PDMS surface [36].



2 Cell viability assay

PDMS was shaped into 3 mm diameter discs, and these discs were immersed in 75% (v/v) ethanol for ultrasonic cleaning for 15 min and then washed three times with PBS. Then, these discs were put into a 48-well flat plate, and the NIH3T3 (Institute of Basic Medical Sciences of the Chinese Academy of Medical Sciences) suspension was seeded on the bottom surface of the sample with 5000 cells. The cells in the pure medium were added as the blank control group. Cell Counting Kit-8 assessed cellular viability post-seeding for days 1, 3, and 5. The samples with adhered cells were taken from the well plate and washed three times with PBS, and then they were transferred to

a new well plate. After that, 10wt% CCK-8 reagents were soaked into the culture medium, and then, they were added to each well to incubate with the sample for 4 hours. Finally, 100 μL of the solution was taken from each well, and their absorbance was measured at a wavelength of 450 nm by a microplate reader (Thermo Varioskan Flash, USA).

2.1 Cell viability assay of PDMS

Compared to the control group, the cell viability of PDMS-O_2, PDMS-two-step, and PDMS-three-step was increased after 24 hours of incubation. The results were attributed to the modified PDMS surface being hydrophilic and multi-layered, increasing cell adhesion and promoting cell attachment and growth. Although the cell viability of PDMS gradually decreased over time, it maintained a cell viability of over 80%. There was no significantly different from that of the control group (Figure S2a). The cell morphology of PDMS-0, PDMS-O_2, PDMS-two-step, and PDMS-three-step remained intact and fibroblast-like, cultivating with NIH3T3 for 1 day, 3 days, and 5 days. NIH3T3 adhered well to the PDMS surface, forming a network of interconnected fibers. Furthermore, no significant differences in cell morphology were observed between the four types of PDMS surfaces (Figure S2b).

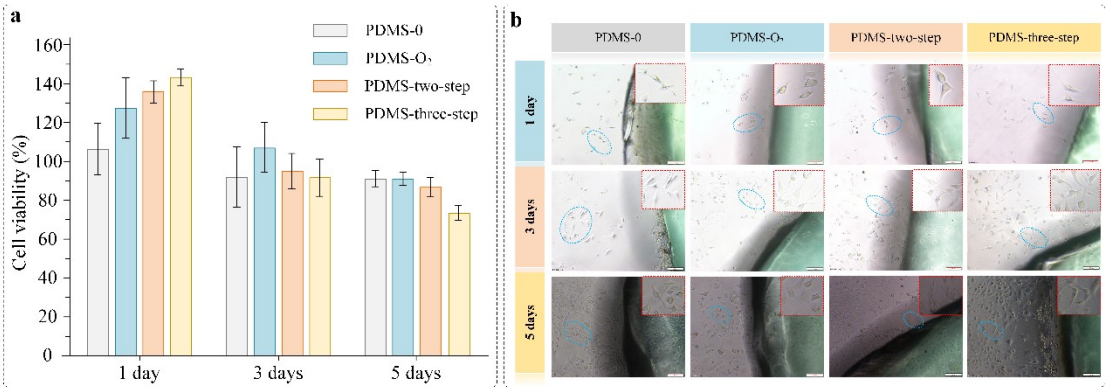


Figure S2. The cell viability of NIH3T3 incubated with PDMS (a) Percentage of NIH3T3 cells viability at various types. The experiments were conducted in quadruplicate independently (n = 4), and the data were expressed as the means ± standard deviation (SD) with $p < 0.05$; (b) Cell morphology of NIH3T3 cells. All images were obtained at 10 magnifications with a scale bar of 100 μm.