Supplementary information

The relationship between cell adhesion force activation on nano/micro-

topographical surfaces and temporal dependence of cell morphology

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Fig. S1  The physical and chemical characteristics of a cerium oxide nanoparticle-dispersed PLLA matrix nanocomposite surface: (a) X-ray diffraction spectra of cerium oxide nanoparticles (CNP), CNP nanolayer deposited on PLLA substrate\textsuperscript{1-3} and PLLA/CNP nanocomposite, measured by X-ray diffraction analysis (RINT 2500, Rigaku Corporation, JAPAN); (b) element spectra of PLLA matrix, CNP nanolayer deposited on PLLA substrate\textsuperscript{1-3} and PLLA/CNP nanocomposite, detected by Field Emission Scanning Electron Microscopes (FE-SEM, S-4800, Hitachi High-Technologies Corporation, JAPAN) combined with Energy Dispersive X-ray spectrometry (EDX, E-MAX Evolution, Horiba Ltd., JAPAN); and (c) chemical bond spectra of PLLA matrix and PLLA/CNP nanocomposite, detected by Attenuated Total Reflection–Fourier Transform Infrared spectrometer (ATR-FTIR, Nicolet 4700, Thermo Fisher Scientific K.K. JAPAN). This data confirms that the top surface of PLLA/CNP nanocomposite can be used as a nano-rough PLLA surface.
Fig. S2  Histogram of cell detachment force and work on flat and nano-topographical surfaces at cell adhesion time after initial attachment on the cantilever, $t_a < 1$ h and $t_a > 1$ h.
Table S1  Detailed measurement conditions of cell detachment force properties on substrates in each figure.

<table>
<thead>
<tr>
<th>α</th>
<th>Measured-cell detachment force (F) and/or work (W) on α-substrate</th>
<th>Time periods</th>
<th>μ on β</th>
<th>μ</th>
<th>Functionalization on cantilever</th>
<th>μ+</th>
<th>Force activation on topography</th>
<th>Fig.</th>
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</thead>
<tbody>
<tr>
<td>Scope 1</td>
<td>Nano-rough Nano / Flat</td>
<td>Initial</td>
<td>&lt; 1 h</td>
<td>TL-cantilever</td>
<td>Con A</td>
<td>1 s</td>
<td>○</td>
<td>5c</td>
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<tr>
<td></td>
<td></td>
<td>Nano / Flat</td>
<td>Intermediate</td>
<td>&lt; 1 h</td>
<td>TL-cantilever</td>
<td>Con A</td>
<td>1 s</td>
<td>X</td>
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<tr>
<td>Micro-Dot</td>
<td>Dot 5</td>
<td>Initial</td>
<td>&lt; 1 h</td>
<td>TL-cantilever</td>
<td>Con A</td>
<td>1 s</td>
<td>X</td>
<td>5b</td>
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<tr>
<td>Micro-Dot</td>
<td>Dot 5</td>
<td>Intermediate</td>
<td>&lt; 1 h</td>
<td>TL-cantilever</td>
<td>Con A</td>
<td>10 s</td>
<td>× / ○</td>
<td>5c</td>
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<td>Micro-Dot</td>
<td>Dot 40 / Flat</td>
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<td>&gt; 1 h</td>
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<td>10 s</td>
<td>○</td>
<td>5d. 5e</td>
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<td>Initial</td>
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<td>TL-cantilever</td>
<td>Con A</td>
<td>1 s</td>
<td>○</td>
<td>7a</td>
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<tr>
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<td>Line 5 / Flat</td>
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<td>Con A</td>
<td>10 s</td>
<td>○</td>
<td>7a</td>
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<tr>
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<td>Line 5 / Line 40</td>
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<td>&gt; 1 h</td>
<td>TL-cantilever</td>
<td>Con A</td>
<td>10 s</td>
<td>○</td>
<td>7b. 7c</td>
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<td>Scope 2</td>
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<td>TL-cantilever</td>
<td>Con A</td>
<td>10 s</td>
<td>○</td>
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<td>2 - 12 h</td>
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<td>10 and 50 s</td>
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<td>Long-term**</td>
<td>&gt; 24 h</td>
<td>Line 5</td>
<td>FN</td>
<td>100 s**</td>
<td>○</td>
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</table>

* Duration time of a cell (immobilized on TL-cantilever) on α-substrate
** Duration time of a cantilever (NSC12, type C) on cell surface, necessary to capture a cell from α-substrate.
*** To evaluate cell adhesion force in long-term periods, a cell-capture method, in which a cantilever directly captures a cell attached on α-substrate, is used.

Reference