BIOMEDICAL NANOSTRUCTURES

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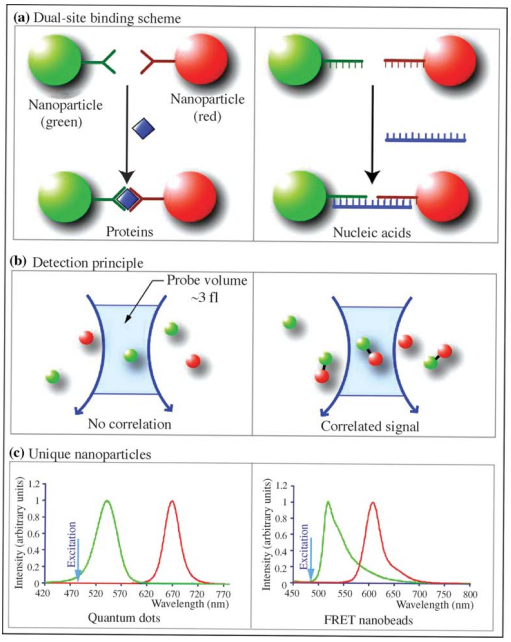

FIGURE 8.4 Single-molecule sandwich assays using color-coded nanoparticles. (a) Simultaneous double-site binding for protein and nucleic acid detection; (b) free nanoparticle probes and bound sandwich pairs moving across a tightly focused laser beam; and (c) fluorescence emission spectra of color-coded quantum dots and energy-transfer nanoparticles. The left panel shows green and red QDs simultaneously excited with a single light source at 420 nm, and the right panel shows green and red energy-transfer nanoparticles excited at the same wavelength. The arrows indicate the relative position of the excitation laser wavelength (488 nm) used in single-molecule detection.

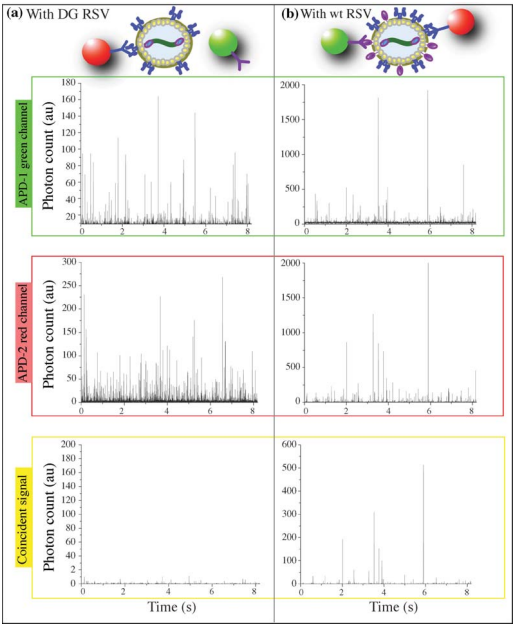

FIGURE 8.6 Counting viral particles in solution. The 40-nm nanoparticles conjugated to RSV anti-F or anti-G protein monoclonal antibodies were used to produce red or green photon emission, respectively. RSVΔG, used as a control, produced low green photon counts as expected and did not show coincidence signals (a), while coincident peaks were observed for RSV/A2 (b).

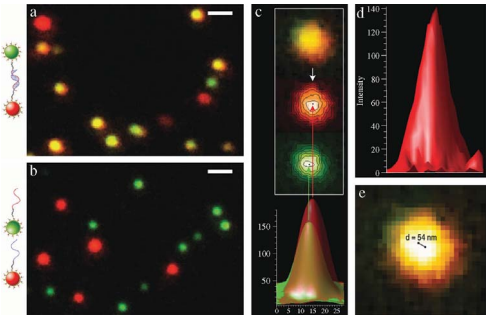

FIGURE 8.7 Dual-color imaging and colocalization of nanoparticle probes at nanometer precision. (a and b) Nanoparticles form diffraction-limited pairs resulting in color change only in presence of complementary sequences. (c) Image of a real R–G bead pair separated into red and green components that are convolved with a Gaussian kernel to determine center. (d) High SNR

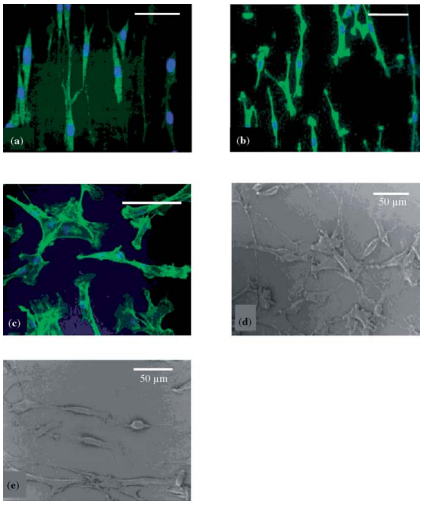

FIGURE 10.4 Confocal micrographs of F-actin stained SMCs on (a) nanoimprinted on PMMA, (b) PDMS, and (c) nonpatterned PMMA surfaces (scale bar 50 μm). SEM micrographs on (d) nonpatterned PMMA and (e) nanoimprinted surfaces show elongated structures on patterned surfaces. (Reprinted with permission from Reference [78].)

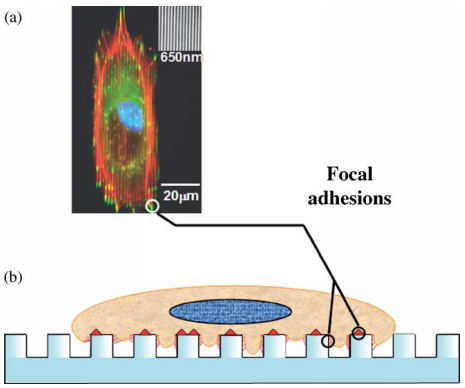

FIGURE 11.6 Focal adhesions anchor cells to nanogrooved surfaces. (a) Cells and their actin filaments (red) align parallel to grooves. Antibodies against vinculin (green) show focal adhesions are also aligned with the nanogrooved surface. (b) A side model of a cell growing on nanogrooved topography. The cell will form focal adhesions (red) on the top of the ridge and down along the walls of the groove. It should be noted that cells residing on the smallest nanoscale features usually lie across the ridges and do not invest the grooves with cellular elements.

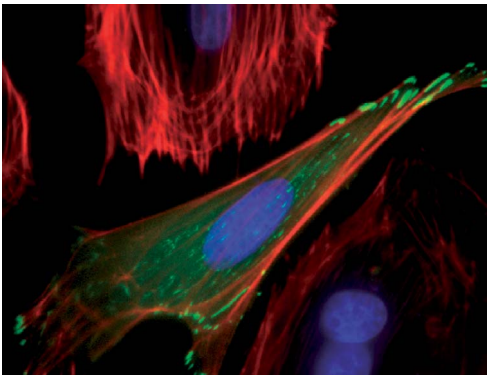

FIGURE 12.1 Fluorescence image of a single capillary endothelial cell expressing GFP-vinculin (green), stained for F-actin with Alexa 468-phalloidin (red), and nuclei with DAPI (blue). Note how each actin stress fiber anchors to focal adhesions at its distal ends (bar = 10 μm).

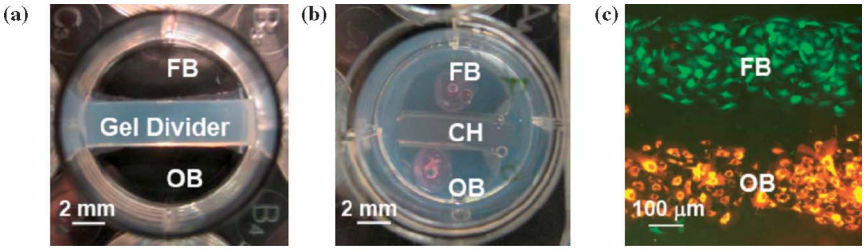

FIGURE 14.2 Examples of cell–cell interaction models used in interface tissue engineering: (a) Coculture of fibroblasts and osteoblasts with temporary agarose gel divider; (b) triculture of fibroblasts and osteoblasts with chondrocytes encapsulated in 3D hydrogel; (c) microscale coculture of fibroblasts and osteoblasts using microfluidic patterning techniques. FB: fibroblasts, OB: osteoblasts, CH: chondrocytes.

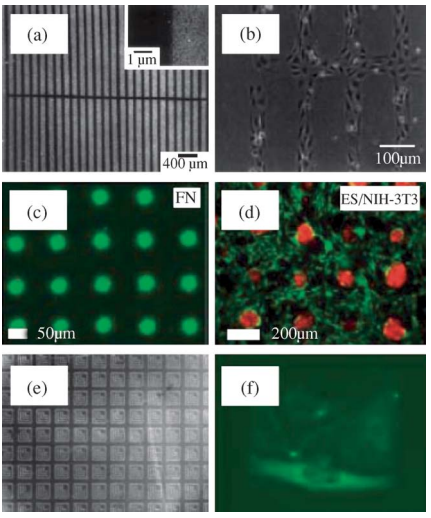

FIGURE 15.4 Surface patterning using various novel techniques. optical micrographs of microcontact printed SAMs on gold having patterned regions with (a) fibronectin (black in color) and (b) bovine capillary endothelial cells (reproduced from Reference [56] with permission, 1997, Academic Press). Layer-by-layer deposition using capillary force lithography method; (c) fluorescence image of fibronectin adsorption on hyaluronic acid patterned surface and (d) fluorescent image of patterned 1-day-old cocultures of ES cells (red) with NIH-3T3 fibroblasts (green) (reproduced from Reference [62] with permission, 2003, Elsevier Ltd). (e) Fluorescence micrograph showing selective protein adsorption to adhesive APS regions (line width of $L = 4$ μm) and (f) reflectance image of green fluorescence protein-tubulin transfected HeLa cells adhering to 100 μm^2 island (reproduced from Reference [64] with permission, 2005, Nano Science and Technology Institute.)

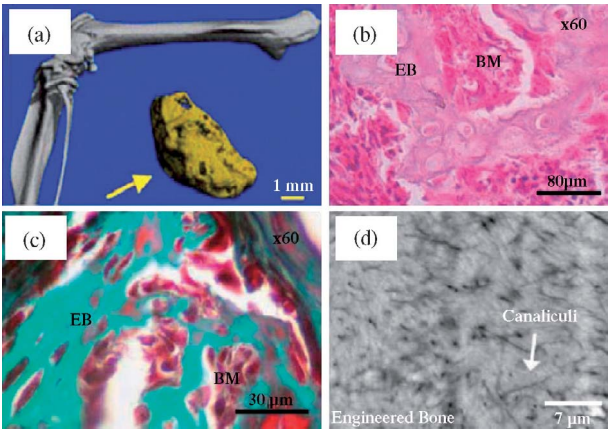

FIGURE 15.6 (a) μCT image of a femoral and engineered bone. Histological evolution of the engineered bone. (b) Hematoxilin–eosin staining for bone marrow regions and (c) Masson's trichrome staining for collagen regions (green in color). (d) Backscattered electron microscope image of an engineered bone showing canaliculi regions similar to the femoral bone (EB is engineered bone and BM is bone marrow). (Reproduced from Reference [79] with permission, 2006, Elsevier Ltd.).

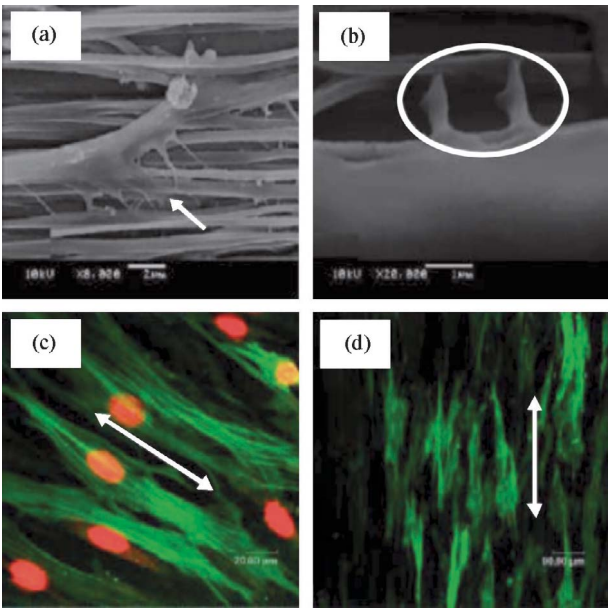

FIGURE 15.7 SEM micrographs showing the SMCs adhesion on the aligned P(LLA-CL) nanofibers: (a) SMC alignment along the fiber orientation with focal contacts and (b) close-up of SMC focal contacts that are attached to the surrounding fibers. Confocal micrographs of SMCs after 1 day culture immunostained for (c) α-actin and (d) myosin filaments. Arrow indicates the fiber orientation. (Reproduced from Reference [88] with permission, 2006, Elsevier Ltd.).