Bifunctional Porous Nanomaterials for Cell-Biomaterial Interaction Studies

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Multifunctional porous nano(micro)meter-scaled materials (NMs) that combine several specific properties (e.g., magnetic, optical, bioactive) have found many applications in biomedical fields such as drug delivery, diagnostic, magnetic resonance imaging, bioseparation etc. The assemblies of such functional NMs on substrate surfaces (arrays of NMs) or in hydrogel networks [nanocomposite (NC) hydrogels of NMs] have been used especially as 2D and 3D biomaterial surfaces to mimic extracellular matrix (ECM) and to study cell-material interactions.[1]

In this context, we use porous NMs, for the preparation of (gradient) 2D and 3D biomaterials to study cell-material interactions and for controlled drug delivery applications (Figure. 1). We describe the external and internal surface functionalization of NMs with (chiral) bioactive molecules and fluorescence dye molecules, respectively,[2] preparation of their arrays[3] and NC hydrogels[4] for controlled cell adhesion and migration, cellular patterning, and chirality-dependent cell enrichment and cell-cell separation.[3-7] Our results demonstrate that different types of cells have different adhesion and proliferation behaviors on the arrays of bifunctional NMs with respect not only to the type of the used bioactive molecules,[2,4,6] but also to the enantiomers of bioactive molecules showing the stereoselective interactions between cell-biomaterial surfaces.[3,7] Additionally, we use functional NMs as nanocontainers to deliver model drug molecules to cells as a proof of principle for controlled drug delivery.[4,7,8]

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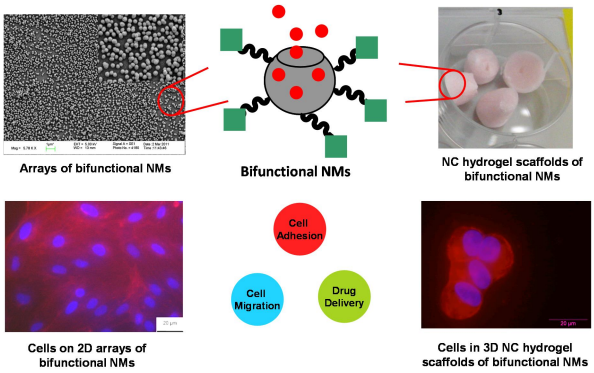

Figure 1. Arrays and NC hydrogels of bifunctional NMs for cell-biomaterial interactions.