

Jeremy J. Ramsden

The bio–nano interface

ABSTRACT. The bio–nano interface comprises three meanings. First is the conceptual one: the “living proof of principle” that nanoscale mechanisms (the subcellular molecular machinery inside a living cell) exist and can function. Within this meaning there is also an inspirational aspect: living cells are known to distinguish between natural structures differing from one another at the nanoscale, suggesting that artificial mimics may also be used to invoke specific living responses. Second is the man–machine interface aspect: how can humans control atomic-scale assembly? Conversely, how can atomic-scale assembly be scaled up to provide artefacts of human dimensions? Third is the literal physical boundary between a living organism and a nanomaterial, device or system. This applies both to nanobiotechnology (the application of nanotechnology to biology, e.g., implantable medical devices) and bionanotechnology (the use of biological molecules in nanodevices). This “bio–physical” interface has several characteristic scales from the biological viewpoint: organismal, cellular and biomolecular. We examine each scale, considering the bio–nano as a special case of the general problem of the bio–nonbio (living–nonliving) interface. Metrology aspects are also considered. Finally, the aspect of the largest biological scale, that of the interface between society and nanotechnology, is discussed.

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