Convergence of nanotechnology and microbiology: Emerging opportunities for water disinfection, integrated urban water management, and risk assessment

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The extraordinary properties of some nanomaterials offer leapfrogging opportunities to develop next-generation applications for drinking water disinfection and safer wastewater reuse (e.g., photocatalytically-enhanced disinfection, biofouling-resistant membranes, and biofilm- and corrosion-resistant surfaces). The multifunctional and high-efficiency processes enabled by nanotechnology are broadly applicable in both industrialized and developing countries, by enabling the retrofitting of aging infrastructure and the development of high performance point-of-use devices that facilitate differential water treatment and reuse. On the other hand, the use of nanomaterials in commercial products is outpacing the development of knowledge and regulations to mitigate potential risks associated with their release to the environment. Therefore, it is important to understand how engineered nanoparticles interact with microorganisms, which form the basis of all known ecosystems and provide critical environmental services such as nitrogen cycling. The convergence of nanotechnology with environmental microbiology could expand the limits of technology, enhance global health through safer water reuse, and contribute towards sustainable and integrated water management. This presentation will consider the antibacterial mechanisms of various nanomaterials within the context of environmental implications and applications. Research needs to steward ecologically responsible nanotechnology will also be discussed.