Exploring the live matter interactions of bacteria and human cells with water exfoliated MoS$_2$ nanosheets

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Abstract

The unique physicochemical properties of two-dimensional materials (2DMs) such as MoS$_2$ and WS$_2$ can be exploited in applications ranging from leading edge nanoelectronics [1] to the frontiers between biomedicine and biotechnology [2]. The potential use of transition metal dichalcogenide (TMD) crystals in biomedicine can be utilized by adopting green and scalable routes of production in biocompatible solvents. Moreover, the potential impact of 2DMs on live matter, their toxicity and antimicrobial activity still remain an open issue to explore more. Taking into consideration the current demands of 2D TMDs, we have produced high-quality, few-layered and defect-free MoS$_2$ layered nanosheets, exfoliated and dispersed in pure water [3], stabilized up to three weeks. Hence, we studied the impact of this material on human cells by investigating its interactions with three cell lines: two tumoral, MCF7 (breast cancer) and U937 (leukemia), and one normal, HaCaT (epithelium). We observed novel and intriguing results, exhibiting evident cytotoxic effect induced in the tumor cell lines, absent in the normal cells in the tested conditions. The antibacterial action of MoS$_2$ nanosheets is investigated against a gram-negative bacterium such as two types of Salmonellas: ATCC 14028 and wild-type Salmonella typhimurium, which is quite dangerous in food-related applications. Additionally, concentration and layer-dependent modulation of cytotoxic effect is found both on human cells and Salmonellas.

References


Figures

Figure 1: Interaction pathway for adhesion (MCF7 and HaCaT cells) and suspension cells (U937) with 2D MoS$_2$ nanosheets.