

Exploring the live matter interactions of bacteria and human cells with water exfoliated MoS₂ nanosheets

Jasneet Kaur^{1,2}, **Manjot Singh**¹, Carmella Dell'Aversana³, Rosaria Benedetti³, Paola Giardina², Manuella Rossi⁴, Mohammadhasan Valadan¹, Alessandro Vergara², Anna Cutarelli⁵, Angela Michela Immacolata Montone⁵, Lucia Altucci³, Federica Corrado⁵, Angela Nebbioso³ and Carlo Altucci^{1,*}

¹Department of Physics, "Ettore Pancini", University of Naples "Federico II", Naples, Italy.

²Department of Chemical Sciences, University of Naples "Federico II", Naples, Italy. ³Department of Precision Medicine, University of Campania "L. Vanvitelli, Vico L. De Crecchio" 7, 80138, Naples, Italy. ⁴Department of Earth, Environment and Resources Sciences, University of Naples "Federico II", Naples, Italy. ⁵Experimental Zooprophyllactic Institute of Southern Italy, Portici, Italy

altucci@na.infn.it

Abstract

The unique physicochemical properties of two-dimensional materials (2DMs) such as MoS₂ and WS₂ 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 onto 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 MoS₂ 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 MoS₂ 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

- [1]. Heine, T. *Acc. Chem. Res.* 48, (2015), 65–72.
- [2]. Chen, Y. et al., *Chemical Society Reviews* 44, (2015), 2681–2701.
- [3]. Pan, L. et al., *Small*, 12, (2016), 6703–6713.

Figures

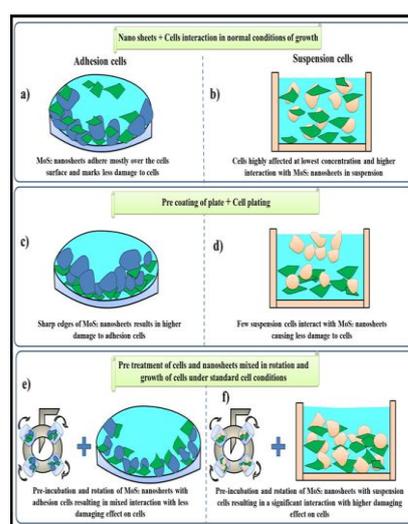


Figure 1: Interaction pathway for adhesion (MCF7 and HaCaT cells) and suspension cells (U937) with 2D MoS₂ nanosheets