Risks derived from the use of nanomaterials in 3D printing of scaffolds

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3D polymer printing has opened new possibilities for developing scaffolds for bone tissue regeneration. Nanocomposites filled with layered hydrotalcite, zirconium phosphate, nanohydroxyapatite and reduced graphene oxide have been produced to enhance the scaffolds functionalities. Workers involved in the different manufacturing processes can be exposed to nanoparticles. In this work, the potential risks for workers derived from the use of nanomaterials during new scaffolds manufacturing are analysed. This work has been carried out in the frame of the Horizon 2020 FAST project (grant agreement no 685825)

The two components of risk, hazard and exposure are being analysed.
Cytotoxicity assessment of the four above mentioned nanofillers has been carried out on five different cell lines, representing main exposure routes (MRC-5 fibroblast, liver HepG2, skin-3T3, and monocytic cell line THP). According to the results, the toxicity of the fillers is cell dependent. The lowest Ic50 values have been observed for rGO samples and highest ones for Zirconium phosphate nanoparticles.

Occupational exposure to nanomaterials is being evaluated following the tiered approach proposed by the OECD (2015) [1]. Work performed includes the identification of exposure scenarios in the processes involved, from nanoparticles synthesis to 3D printing. Qualitive risk assessment has been performed to identify key exposure scenarios using control banding tools such as Stoffenmanager Nano and CB nanotool [2]. Results showed that, in general, scenarios have low risk profiles since nanomaterials are handled as dispersions or fixed in polymer matrices. Furthermore, adequate, engineering controls are implemented. Future activities will include the quantitative assessment of workers exposure during graphene production.

References

[1] OECD (2015) Harmonized Tiered Approach to Measure and Assess the Potential Exposure to Airborne Emissions of Engineered Nano-Objects and their Agglomerates and Aggregates at Workplaces, 2015.
[2] Sánchez Jiménez, A., Varet, J., Poland, C., Fern, G. J., Hankin, S. M., & van Tongeren, M. (2016). A comparison of control banding tools for nanomaterials. Journal of occupational and environmental hygiene, 13(12), 936-949.Sanchez et al 2016

Figures

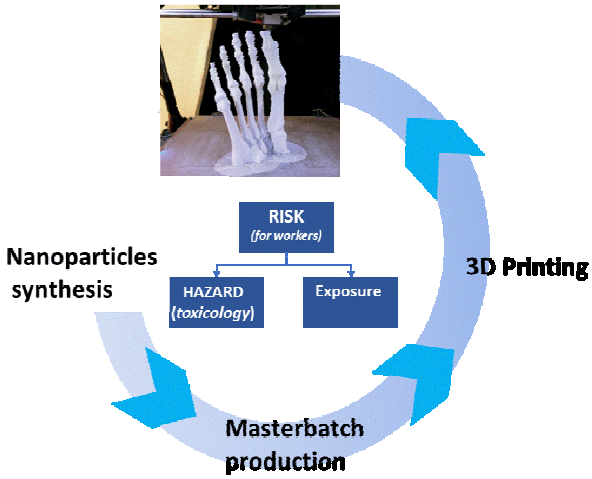

Figure 1: Risk assessment in FAST project