Interaction of single and multi-layer graphene oxide with fetal bovine serum: assessing the protein corona formation

Lidiane Silva Franqui1,2, Marcelo Alexandre De Farias1, Rodrigo Villares Portugal1, Carlos Alberto Costa1, Vitor Rafael Coluci2, Adriana Franco Paes Leme1, Diego Stefani Teodoro Martinez1,2

1Brazilian Center for Research in Energy and Materials, 2University of Campinas

e-mail: lidiane.franqui@pos.ft.unicamp.br

When in contact with biological systems, nanomaterials surface adsorbs biomolecules present in the biological medium, mainly proteins, yielding a molecular coating called “protein corona”, which affects the biological response and toxicity of the nanomaterials. Several factors can influence the protein corona formation, such as nanomaterial physicochemical properties and the nature of biological medium. In this work, we have performed a comparative study between the single and multi-layer graphene oxide nanomaterials (SL-GO and ML-GO, respectively) after their interaction with DMEM cell culture medium containing fetal bovine serum (FBS). Bare GOs and FBS protein corona-coated GOs were characterized using dynamic light scattering (DLS), nanoparticle tracking analysis (NTA), atomic force microscopy (AFM), cryogenic transmission electron microscopy (Cryo-TEM) and X-ray photoelectron spectroscopy (XPS). The protein corona composition was characterized by gel electrophoresis (SDS-PAGE) and mass spectrometry (LC-MS/MS). Our results showed that, after interaction with FBS, GO particle size increased due to the protein corona formation. Besides, the presence of proteins also has significantly increased the dispersion stability of SL-GO and ML-GO over time. Whereas the main proteins have been identified in both SL-GO and ML-GO, SL-GO has adsorbed larger amounts of proteins than ML-GO. Finally, the number of GO layers influences its interactions with FBS proteins and dispersion stability in DMEM medium. These results point out implications for in vitro cytotoxicity assessment and biomedical applications of these promising carbon nanomaterials.

Acknowledgments:
CAPES, CNPq, FAPESP, Cigenanotox, CBCIN and SisNANO-MCTI.