Impedancemetry and toxicology of nanomaterials: a review on an emerging alternative method

Jacques-Aurélien Sergent¹, Emilie Viev², Erik Van Miert¹

Contact: jacques-aurelien.sergent@solvay.com; Tel +32 2 264 34 04

¹Toxicological and Environmental Risk Assessment Unit, Solvay, Brussels, Belgium
²ACEA Biosciences, California, United-States

State of The Art:

- Automated continuous measurement (96 or 384 well plates)
- Physiological Parameter: Cell Index (CI)
- Cell Index is reflecting 3 key parameters:
  - Cell number
  - Cell adhesion
  - Cell morphology

Shape of CI curve allows differentiation between the 3 key parameters

Table 1: Applications of Impedancemetry to evaluate nanomaterials in vitro

- Requires adherent cells
- No invasive methodology, possibility to double process cells with confocal microscopy, flow cytometry...
- Possibility to monitor: Proliferation, Cytotoxicity, Apoptosis, Receiver-mediated signaling, Tight junctions, Cell migration, Morphological brisk modifications...
- No known interference between nanomaterials and measurement process

Table 2: NMs Physico-Chemical Characterization

Discussion and Perspectives:
- Proliferation
  - Carbon Black (CB): limited effects on proliferation except for high dose
  - Graphene Oxide (GO): does not depend on response
  - Reduced Graphene Oxide (RGO): does depend on response. CB surface is twice the one of GO
  - Expanded Graphite (EG): high impact starting at 0.5µg/mL

- Cell-Cell interaction
  - Carbon Black (CB): very limited effects on cell-cell interactions
  - Graphene Oxide (GO): transient effect but no long term effects
  - Reduced Graphene Oxide (RGO): transient effect but no long term effects
  - Expanded Graphite (EG): high impact starting at 0.5µg/mL

Highlights on transient effects
- Good correlation with literature
- Surface based approach activity CB < RGO < GO < EG
- Useful and rapid first line tool (screening assay)
- Possibility of conduct on the same cells confocal microscopy, flow cytometry...
- Cellular kinetics: monitoring short time (transient) versus long term effects
- Identity time point of interest for further testing

Figures: Real-Time monitoring of exposed cells response

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