# Interactions between nanomaterials and human erythrocytes and nanomaterials and cells of digestive glands of model invertebrate organism

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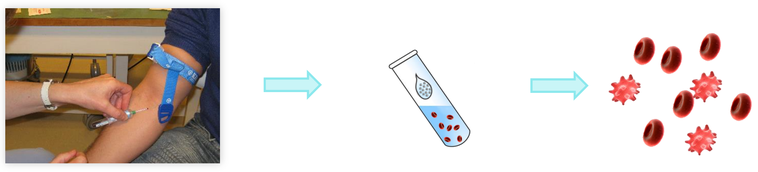
## Introduction and aim of the study

Nanomaterials (NMs) interact with cells in a number of ways, and can manifest as adsorption of aggregates of different NMs on cell surfaces, morphological alterations of cells and internalization of NMs. We hypothesised that interactions between aggregates of NMs and red blood cells (RBCs) or cells of digestive glands of model invertebrate organism depend on the chemical composition of particles, their surface characteristics, shape and size. During the QualityNano-funded Transnational Access visit to NHM the adsorption of aggregates of tungsten (WO nanotubes) and molybdenum (MoS nanowires) NMs on RBC surfaces was investigated with scanning electron microscopy (SEM) and chemical analysis of the NP aggregates was performed with Energy-dispersive X-ray spectroscopy (EDX). We expected to see morphological alterations of RBCs due to their interaction with the NMs, which was indeed confirmed, as was the presence of the MoS nanowires in some digestive glands of our test organism - *Porcellio scaber* (Isopoda, Crustacea).

## Methods

### 1) Behaviour of nanomaterials (NMs) in blood of healthy individuals

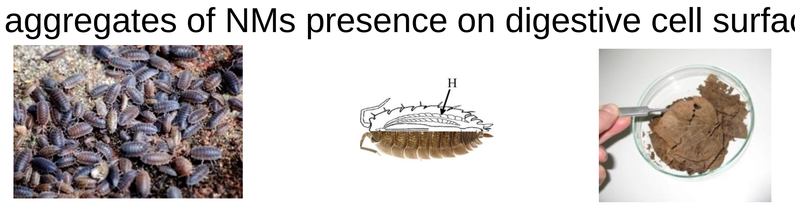
- Haemocompatibility of NMs according to: ISO 10993-4 protocol for testing haemocompatibility of biomaterials
- Observation of shape transformations of red blood cells (RBCs) after incubation with tungsten or molybdenum NPs with scanning electron microscopy (SEM)



Isolated RBCs incubated with tungsten nanotubes and molibden nanowires

### 2) Morphological alterations of digestive gland tissue of model animal *Porcellio scaber* after NMs exposure

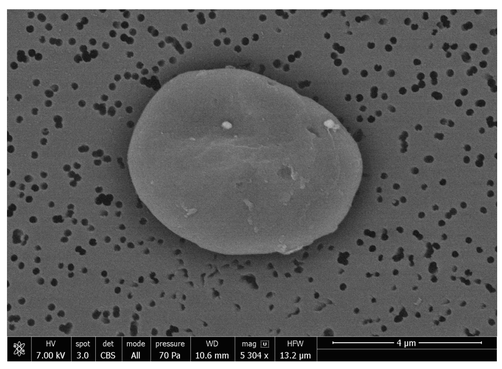
- *In vivo* feeding experiment: 14 day exposure of isopods to tungsten and molybdenum NMs
- Observation of morphology alterations of isolated digestive tissue of model organism after exposure to NMs via SEM
- Analyse aggregates of NMs presence on digestive cell surfaces with EDX



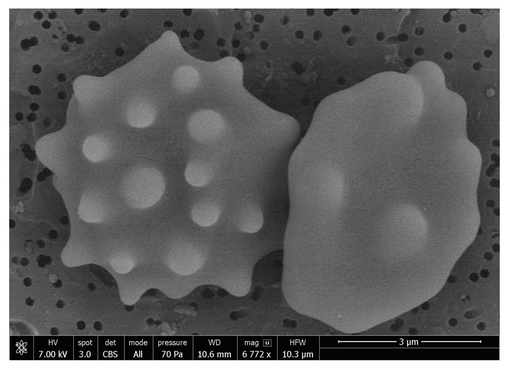

*Porcellio scaber* (Isopoda, Crustacea)

## Results

### 1) Shape transformations of RBCs after incubation with NMs



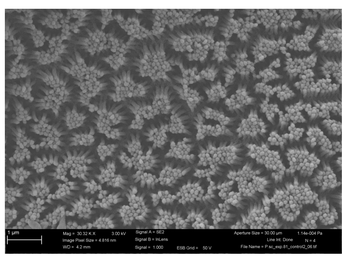

Control RBC (discocytes)



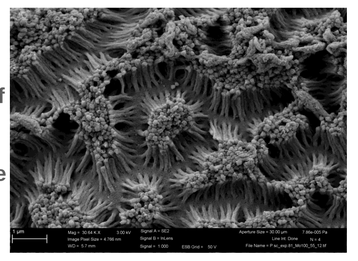

RBC after exposure to MoS nanowires (echynocytes)

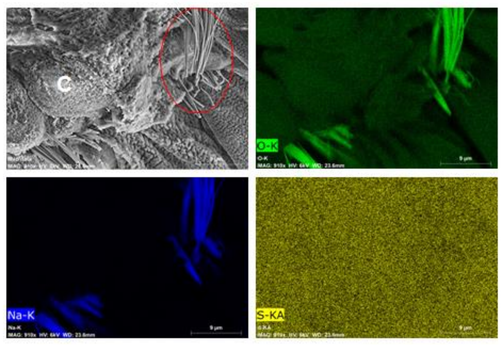
### 2) Presence of NPs in digestive gland tissue of model organism

Microvilli of digestive gland cell of control animal



Changed morphology of microvilli of digestive gland cell of animal expose to MoS nanowires






Digestive gland cells (C) with structures shaaped like MoS nanowires (circuled). EDX analyses showed that this is organic material and NOT the nanowires.

## Outputs

- High resolution images of digestive gland tissue of model animal exposed to NMs which will be used in our future publications.
- Results of EDX analyses of digestive gland tissue enables us to continue the study of presence of NPs in digestive glands.
- A large data set of RBC images exposed to NPs – *data processing in progress.*
- Publication planned for late 2015 involving UniLj and NHM co-authors.

## Benefits of TA

The NHM visit was an excellent opportunity to broaden and acquire new skills in the field of electron microscopy in correlation with nanobiology.

The NHMs FEI Quanta 650 FEG SEM enables high resolution images of non-conductive and highly topographic biological tissue and ultra-fast and shadow-free semi-quantitative elemental analysis and hyperspectral mapping of tissue with Bruker Flat Quad 5060F EDS. These images could not have been obtained without the QulaityNano TA visit.

## Other highlights / expertise gained / collaborations /

- Had an opportunity to present my research to the NHM team.
- Experienced a different research environment and culture.
- Expanded my research network – collaboration continuing via UoB.
- Learned new approaches and skills, specifically around SEM and EDX.

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