Introduction

Understanding properties of engineered materials and how they affect biological systems, human health, and the environment is a relatively new area of scientific study which requires long term efforts. On the other hand, timelines of obtaining adequate scientific understanding greatly mismatch those of product innovation and market distribution. Addressing this concern, the NanoStreeM project focuses on identifying gaps in the current understanding of the occupational hazards related to the use of nanomaterials in the semiconductor industry.

On 10th Nov 2016 the NanoStreeM consortium organized a workshop entitled "Nanomaterial Risk Assessments and communication of their findings". The workshop was held as a satellite event at the NanoSafe 2016 conference. The event explored some of the findings of NanoStreeM in the nanomaterial trajectory investigation for a typical semiconductor FAB. The workshop gathered participants and speakers from the industry and the academia.

Summary of the contributions

- **Dimiter Prodanov (IMEC)** gave an overview of the project goals and the strategy of the project. In particular he emphasized the diversity of the chemical products used in semiconductor industry in view of the CMOS scaling requirements and roadmap.

- **Pascal Roquet (ST)** gave an overview of the investigated nanomaterial trajectories in a semiconductor fab giving examples by chemical mechanical planarization (CMP). The presentation concluded with the following statements
  - The list of nanomaterial trajectories related to tasks and operations within semiconductors facilities served as the basis to select candidate exposure scenarios for deeper consideration within the Nanostreem consortium.
  - CMP slurry is the well-established nanomaterials used within the semiconductor sector. The vast majority of nanomaterial trajectories listed in the inventory fall into this category.
Nevertheless, a certain number of tasks with potential exposure to environment, including potential high exposure rating were identified. It confirms the need of further investigations and study within the NanoStreeM project.

- **Michel Masselot (ST)** gave an overview of how the Nano risk related to CMP activity is handled in one of the largest manufacturing Fab of ST (Crolles / France). The presentation highlighted the general approach introduced in 2008 by cooperation with French authorities and expert groups (INERIS, CEA), including formal training of “Nano preventer”, then using some measurement campaigns to include concrete elements within the risk analysis, and so contributed to confirm some hypothesis.

- **Lieve Geerts (VITO)** gave an overview of the techniques of the environmental impact assessment. In particular she gave the example of the CMP slurry, which is identified as a class of nanomaterials with potential environmental impact and the ways to assess it.

- **Eric Zimmermann (CEA)** gave an overview of the measurement techniques for nanomaterials with particular emphasis on air and water sampling studies.

- **Daniela Iacopino (Tyndall)** gave an overview of the safety training available within the consortium and stressed that only 4 partners out of 14 had training specific to nanomaterials. The end users panorama was also found quite broad and in need of different information, ranging from researchers to management to safety officers. The online tools (training, videos, websites etc) available within the consortium were found to be even scarcer. This highlighted the need for development of more online tools within the consortium as well as the need to develop custom made safety training packages tailored to researchers, management and safety officer end users.

- **Samuel Butcher (Labster)** gave an overview of the Labster online learning platform. The platform utilizes game-based learning strategy in order to improving learning of lab safety. At present there are 3 simulation environments, which can be potentially suitable for nanosafety.

- **Pasqualantonio Pingue (SNS)** gave an overview of the NanoLab project running in Italy. The aim of the project is to develop novel tools for risk prevention and safety management of NMs in R&D laboratories, on the basis of a precautionary approach aiming to ensure a safe and successful development of NMs. Dr. Pingue emphasized the differences of the risk classification coming out form different Risk Assessment tools currently being in use or development.

**General discussion**

The workshop concluded with a general panel discussion, which can be summarized as follows:

- The external speakers and the audience fond the approach followed by NanoStreeM as valuable. Specifically, the involvement of the industry and the applicability of the approach were appreciated.

- Advanced materials, such as graphene and other carbon materials can be approached from the same perspective as the engineered nanomaterials investigated by the NanoStreeM consortium.
• The environmental release of nanomaterials can be a potential issue and more effort is needed in this direction
• Innovative interactive training platforms, such as Labster, can be considered for deployment of general semiconductor-related safety trainings.
• In particular, for nanosafety, because of the higher degree of learning necessary, this can be the best choice.