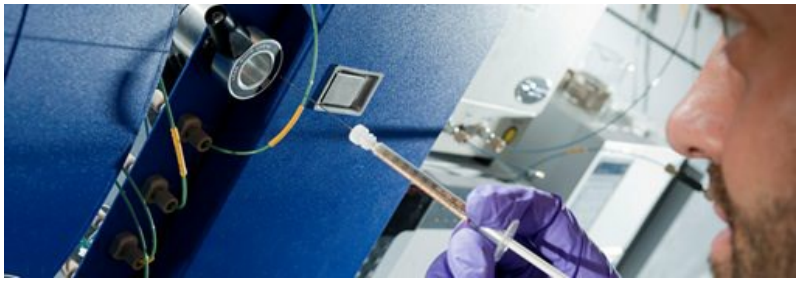
Environmental Nanoscience



Nanoscience is the science at the nanoscale, where 'nano' refers to processes that occur on the size range between 1 and 100 nm. At this length scale, material properties can be dominated by size-dependent features, such as quantum confinement and surface plasmon resonance. In simple terms, within the nanoscale materials can behave in novel and unexpected ways. Furthermore, due to their very small size, the surface to bulk ratio of nanomaterials is exceptionally high, a feature that also alters their properties enormously.

It is possible that along with novel physicochemical properties nanomaterials may also develop toxicity in novel or unexpected ways. A new research area, nanotoxicology, has emerged in recent years, aiming to elucidate the toxicity potential of nanomaterials. Scientists at Birmingham are international leaders in nanotoxicology. We coordinate or participate in a number of EU funded projects: **ModNanoTox (/generic/modnanotox/index.aspx)** , **QNano (http://www.qnano-ri.eu/)** , **NanoValid (http://www.nanovalid.eu/)** and **MARINA (http://www.marina-fp7.eu/project/)** . We are also involved in UK NERC funded projects.

Our research focuses on understanding reactivity at the nanoscale, particularly where this influences the environmental fate and behaviour of nanomaterials. We study many aspects of the interactions of nanomaterials with pollutants and biota, biomineralisation processes, and the behaviour of manufactured and natural nanoparticles in the environment. We have pioneered methodologies such as stable isotope labeling and detection of nanomaterials. We carry out our work in state of the art analytical facilities in Birmingham, including the NERC funded **FENAC (Facility for Environmental Nanoscience Analysis and Characterisation) (/facilities/fenac/index.aspx)** .

Much of our work in this area is carried out in collaboration with other major research teams in Birmingham (Biosciences and Physics) as well as external partners including other UK/EU universities and government departments, private sector organisations and overseas collaborators.

Research areas include:

- Engineered nanomaterial synthesis and characterization, covering a very wide range of metals and metal oxides and the development of reliable and reproducible synthesis protocols (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)** and **Lead (/staff/profiles/gees/lead-jamie.aspx)**)
- Engineered nanomaterial behaviour in aqueous media, particularly in terms of the effects on solubility and agglomeration of media organic and inorganic components; formation of "environmental coronas" (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)** and **Lead (/staff/profiles/gees/lead-jamie.aspx)**)
- Development of libraries of reference nanomaterials for nanotoxicology (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)**)
- Stable isotope labeled nanomaterials synthesis and characterization; nanoparticles currently available include Ag, ZnO and CuO (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)**)
- Interaction of a variety of carbon- and metal-based nano-objects with biota in vitro and in vivo, where the primary focus is to assess the sensitivity of different tests and provide better tools to assess toxicity (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)**)
- Molecular simulations of nanoparticle reactivity particularly in order to develop a better understanding of toxicity (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)** and **Martin (/staff/profiles/gees/martin-paul.aspx)**)
- Development of nanosensors for measurements of pH and chemical compositions at micrometer scale (**Shi (/staff/profiles/gees/shi-zongbo.aspx)** , **Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)** , **Lead (/staff/profiles/gees/lead-jamie.aspx)**)
- Nanoparticles in atmospheric depositions (dust, rainwater) and their role in controlling the bioavailability of biogeochemically important nutrients and trace metals to the marine microorganisms (**Shi (/staff/profiles/gees/shi-zongbo.aspx)**)
- Maturation and ageing in biominerals and understanding such processes at the nano-level, focusing particularly on bioapatites (**Valsami-Jones (/staff/profiles/gees/valsami-jones-eva.aspx)**)