



Contribution ID: 40

Type: not specified

## Processing Nanoparticles in Suspension of High Solid Concentration: On-line Characterisation and Process Modelling

*Monday, 9 March 2015 17:18 (24 minutes)*

“Abstract: Manufacture of nanometre particulate form products in suspensions is becoming increasingly important to the pharmaceutical, speciality chemical, and functional material industries. For instance, nano-processing is now used as an effective drug-delivery method for solid form hydrophobic pharmaceuticals due to the dramatically increased drug solubility and bioavailability at nano-scale. The biggest challenge to nano-processing under industrial conditions has been highlighted as the difficulty in achieving consistency in product quality as characterised by particle size distribution. In this work, we report investigation on on-line characterisation and process modelling techniques that can be applied under industrial operational conditions. The research on on-line sensing is based on acoustic spectroscopy for real-time particle sizing. The work will tackle the key challenge posed by multiple scattering and particle-particle interactions, which are known to be the cause leading to incorrect measurement at high solid concentrations. High solid concentration is not only the economically viable range for commercial manufacture of nanoparticles (a much larger reactor would be required to process the same amount of particles in low concentration), but also technically essential for producing ultra-fine particles for many processes. The on-line real-time measurement will provide invaluable data to the development of process models using population balance equations. The focus will be on quantitatively deriving models for particle breakage and aggregation to be used in the population balance equations, as well as intelligent interpretation of the data to improve the qualitative understanding of the process. The process chosen for investigation is wet nano-milling, a very important operation for processing nanoparticles in the pharmaceutical, agrochemical and materials industries.

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**Primary author:** WANG, Xue Z. (Institute of Particle Science and Engineering, School of Chemical and Process Engineering, University of Leeds)

**Presenter:** OKSEL, Ceyda (Institute of Particle Science and Engineering, School of Chemical and Process Engineering, University of Leeds)

**Session Classification:** 2C Industrial decision support tools

**Track Classification:** Parallel session 2C: Industrial decision support tools