IPROCOM - **a Marie Curie Initial Training Network funded by the European Commission under the FP7-PEOPLE-2012-ITN Programme**

IPROCOM (The development of *in silico* process models for roll compaction) is a multidisciplinary and inter-sectoral consortium with an ambition to address scientific and technology challenges in the manufacture of particulate products (pharmaceuticals, catalyst pellets, detergent tablets, fertilizer, biomass and metal components) through a coordinated and structured research training programme.

In particular, IPROCOM aims to develop robust *in silico* process models that can be used to predict the properties of intermediate (ribbons/granules) and final products (tablets/pellets/components) based on the properties of individual particles and to provide structured training for the next generation of researchers who will comprehend such models, associated knowledge and techniques and apply them to a number of industries (such as ceramic, powder metallurgy, food, pharmaceutical, energy, agriculture, mineral, chemicals and recycling industries).

IPROCOM consortium brings together experts from engineering, pharmaceutical science, materials science and computer science disciplines from 10 full partners across Europe including:

University of Surrey (**US**), Guildford, UK (http://www.surrey.ac.uk/cpe/about/);

Heinrich-Heine-University (**UDUS**), Duesseldorf, Germany (http://www.pharmazie.hhu.de/Institute/pharm_tech);

AstraZeneca plc. (**AZ**), Mölndal, Sweden (http://www.astrazenecamolndal.com);

Research Centre Pharmaceutical Engineering GmbH (**RCPE**), Graz, Austria (http://www.rcpe.at/en/index.php);

Ecole des Mines d'Albi (**EM**), France (http://www.mines-albi.fr/);

Vysoka Skola Banska - Technicka Univerzita Ostrava, Czech Republic (http://www.cs.vsb.cz/) & Machine Intelligence Research Labs (MIR Labs, http://www.mirlabs.org/mirlabs.php);

Babes-Bolyai University (**UBB**), Romania (http://www.ubbcluj.ro/);

Jagiellonian University (**JU**), Poland; http://www.farnacja.cm-uj.krakow.pl; http://www.uj.edu.pl;

Johnson Matthey plc. (**JM**), UK (http://www.matthey.com);

Fraunhofer Institute for Mechanics of Materials IWM (**FRAUNHOFER**), Germany (http://www.iwm.fraunhofer.de)

and 4 associate *partners specializing pharmaceutical development, machine manufacturing, multimedia & science communications:*

Bayer Schering AG, Germany (http://www.bayerpharma.com/)

L.B.Bohle Maschinen + Verfahren GmbH, Germany (http://www.lbbohle.de/);

Ark Media Productions, UK (http://www.arkmedia.co.uk);

SkillStudio Limited, UK (http://www.skillstudio.co.uk).

Structured research training in IPROCOM consists of 3 complementary work packages: i) *process understanding through systematic experimental investigation*, ii) *multiscale modeling with discrete element methods (DEM) & Finite element methods (FEM)* and iii) *intelligent modeling with artificial neural networks and evolutionary computation.*

IPROCOM runs 15 cross-linked individual research projects involving 12 Early Stage Researches (ESRs, equivalent to PhDs) for 36 months and 3 Experienced Researchers (ERs, equivalent to postdocs) for 18-24 months as detailed below.

ESR1: *Multi-scale materials characterization of particles and powders. The objectives are to experimentally characterise* particle and powder properties using a wide range of techniques, to identify critical particle characteristics that dominate bulk powder properties, and to investigate powder mixing and quantify the mixing dynamics and microstructures of mixtures. *ESR1 will be based at the University of Surrey, UK.*

ESR2: *Impact of powder properties & system design on roll compaction. The aim of this project is to* explore how material properties, roll compactor type and process parameters affect the roll compaction process, for which ribbon properties produced using various types of roll compactors available in IPROCOM and microscopic flow patterns of particles during roll compaction with different system designs will be characterized. ERS2 will be hosted *at* Heinrich-Heine-University, Germany.

ESR3: *Roll compaction scale-up. The objectives are to* perform a systematic study of roll compaction using roll compactors of different scales and to identify the design space for roll compaction. ERS3 will be hosted *at* Heinrich-Heine-University, Germany.

ESR4: *Milling of roll compacted ribbons & die compaction.* The objective is to explore how ribbon properties and milling conditions affect the granule properties. Microscopic study on fundamental milling mechanisms will be performed. ESR4 will also perform compaction experiments using

both feed powders and produced granules. ESR4 will be based at Ecole des Mines d'Albi, France.

ESR5: *DEM modelling of powder mixing*. The objectives are to analyse powder filling processes using DEM, and to assess flow rate and uniformity, and how particle properties and process conditions will affect the properties of the powder bed in roll compaction. DEM models will be further developed to explore the effects of particle shape, cohesion, agglomeration and electrostatic interactions. ESR5 will be hosted at Research Centre Pharmaceutical Engineering GmbH, Graz, Austria.

ESR6: *FEM modelling of roll compaction.* The objective is to develop predictive models using FEM , which can be used to identify the critical material properties and process parameters controlling the quality of granules. The effects of powder properties and roll compactor types will be investigated. ESR4 will be based at Ecole des Mines d'Albi, France

ESR7: *DEM modelling of ribbon milling.* This project aims to explore the fundamental microscopic mechanisms of ribbon milling using DEM. How ribbon properties and milling conditions affect the microscopic behaviour of milling will be explored. *ESR7 will be based at the University of Surrey, UK.*

ESR8: *DEM and FEM modelling of die filling and compaction of powders and granules*. The goal of this project is to predict final compact properties using a combination of DEM and FEM. A systematic investigation will be performed to examine how granule properties and process parameters affect the die filling behaviour and the subsequent powder compaction and ejection. ESR8 will be hosted at Fraunhofer Institute for Mechanics of Materials IWM, Germany.

ESR9: *Computational Intelligency (CI) modelling of powder mixing*. The objectives of this project are to develop a robust computational intelligence (CI) platform together with ESRs 10-12 and to identify critical particle properties (CPPs) and critical process variables (CPVs) that dominate bulk powder characteristics. ESR9 will be based at **Vysoka Skola Banska - Technicka Univerzita Ostrava, Czech Republic. & Machine Intelligence Research Labs (MIR Labs).**

ESR10: *CI modelling of roll compaction. The objectives of this project are* to develop a robust CI platform together with ESRs 9, 11, 12, to model roll compaction processes and to identify critical powder properties and CPVs controlling ribbon characteristics. ESR10 will be hosted at Babes-Bolyai University, Romania.

ESR11: *CI modelling of milling of ribbons.* The objectives are to develop a robust CI platform together with ESRs 9, 10, 12, to model the ribbon milling process, to predict granule properties based on ribbon parameters and milling conditions, and to identify vital information on critical materials and process variables. ESR11 will be based at Jagiellonian University, Poland.

ESR12: *CI modelling of die compaction*. This project aims to develop a robust CI platform together with ESRs 9-11 and to model the powder

compaction process, from which critical granules and granulation parameters together with process variables will be identified. ESR11 will also be based at Jagiellonian University, Poland.

ER1: *Characterisation of powder properties using DEM*. The objective of ER1 is to characterise bulk powder properties based on the properties of single particles using DEM and to work closely with other ESRs/ERs to devise a multi-scale numerical platform for particulate product manufacturing. ER1 (24 months) will be based at Johnson Matthey plc., UK.

ER2: *DEM modelling of powder mixing*. The objectives of this project are to assess how uniformly particles of different properties can be mixed and to simulate the mixing behaviour of various powders and to investigate the mixing and segregation phenomena using DEM. The effect of packing structure of mixtures on the bulk powder behaviour will also be examined. ER2 (18 months) will be hosted at Research Centre Pharmaceutical Engineering GmbH, Graz, Austria.

ER3: Population balance *modeling of ribbon milling*. The objectives are to develop a population balance model for analysing ribbon milling processes, and to investigate how the ribbon properties, mill type and milling conditions affect the granule size. ER3 (24 months) will be hosted at AstraZeneca plc., Sweden.

The above vacancies are now open and we are looking for energetic candidates with research interests in either particle technology, pharmaceutical technology, computer modeling, DEM, FEM, *artificial neural networks, evolutionary computation* or computational intelligence to join this exciting research training network to work on one of the above projects.

In addition to close research project supervision, ESRs/ERS will also benefit from a wide range of network activities including inter-sectoral secondments, IPROCOM training schools, workshops, short courses, international meetings and network conference.

If you are interested in applying, please email your CV & a cover letter stating which project(s) you are interested to the IPROCOM coordinator Prof. Chuan-Yu (Charley) Wu, C.Y.Wu@surrey.ac.uk.

ESR9: For more technical details, please contact the following:
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