# Dr. Ajit Mujumdar, Instructor

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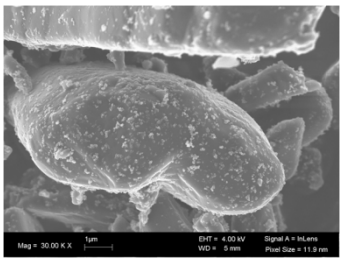
## Education

Ph.D. Mechanical Engineering, New Jersey Institute of Technology, Newark, USA.
M.S. Instrument Technology, Indian Institute of Technology Delhi, India.
B.S. Mechanical Engineering, National Institute of Technology, Nagpur, India.

## Recent Research Projects

Engineered and functionalized active pharmaceutical ingredients (APIs) by dry coating technique:

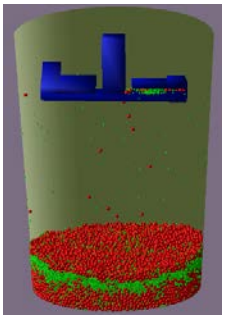


Dry coating is an innovative technique in which nano particles are mechanically coated onto the surface of larger (from a micron to few microns) host particles to impart useful properties to the final product, which are engineered particles. Dry coated engineered particles can have improved flow and handling properties, and hence very useful for a number of industrial applications. In this work, preparation, characterization and applications of such engineered particles for the pharmaceutical applications is carried out. Flow improvement in highly cohesive APIs ex. Acetaminophen, Ibuprofen is quantified.

Magnetically assisted impaction mixing of nano-size particles:

The mixing of nano-scale particles using a novel dry mechanical mixing technique called magnetically assisted impaction mixing (MAIM) has been studied experimentally in this work. Homogeneity of mixing was evaluated at the micron length scale based on field emission scanning electron microscopy (FESEM) images coupled with the energy dispersive x-ray spectroscopy (EDS). In order to achieve the homogeneous mixture of nano-particles, MAIM process was optimized by studying the effects of magnet-to-sample ratio, processing time, magnet size, and constituents of the mixture (binary systems of $SiO_2$+$TiO_2$ and $SiO_2$+$Al_2O_3$). It was found that the mixture homogeneity improved with an increase in the magnet-to-sample weight ratio, processing time and decrease in the magnet size due to increase in the number of collisions between the nano-particles and the magnetic particles.

Discrete element model based numerical simulation of agitator:



A three dimensional numerical code based on the discrete element method (DEM) is applied to simulate the mixing characteristics of ternary system of particles in an industrial agitator. The device consists of blades rotating at 300rpm enabling the rigorous mixing of particles. Cohesive forces based on Van der Waal forces are included for the particles in the submicron range. A Similar Particle Model (SPA) is also used for mimicking the realistic industrial case due to the computational limitations. A magnification factor up to 50 is used in the simulations and its effect on the quality of mixing of particles is compared with the lower magnification factors. Experimental comparison with the numerically simulated results is found to be in good agreement.

All above projects are largely carried out in the Engineering Research Center for Structured Organic Particulates (ERC for SOPS – NSF funded consortium of Rutgers University, Purdue University, New Jersey Institute of Technology and University of Puerto Rico at Mayaguez) and during a JSPS fellowship.