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Development of a Wurster type fluidized bed reactor coupled with an atmospheric plasma jet for the deposition of titanium oxide coating on micrometric particles: experiments and modeling

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In order to deposit photocatalytic TiO2 layers on micrometric particles at large scale, a new process has been developed by combining an atmospheric pressure plasma jet and a Wurster type fluidized bed reactor. Geldart's class A and B particles were chosen as they are non-cohesive and easily aeratable.
A model based on the so-called population balance approach has been developed using a Scilab code, while the two-phase flow CFD model was performed with COMSOL Multiphysics to determine the velocity field inside the reactor and the behavior of particles.
For the experimental part, a pulsed arc atmospheric pressure plasma jet (APPJ) system was used to coat the particles by introducing a vapor of titanium tetraisopropoxide (TTIP) into the air discharge. The plasma torch was introduced into a 100 mm diameter reactor, in the middle of a metallic gas distributor. An internal Wurster tube was added to control the residence time of particles in the plasma jet, and therefore the homogeneity of treatments.

Keywords
Atmospheric Plasma Jet
Fluidized bed reactor
TiO2
Particle population balance
CFD modeling