Controlled surface functionalization of pharmaceutical carrier particles by plasma-assisted dry coating processes

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Current trends in personalized medicine and the increasing need to enhance bioavailability of newly developed, poorly soluble active pharmaceutical ingredients pose significant challenges for drug development and the application of pharmaceutical technologies. The modification of particle surfaces via plasma treatment presents significant potential for improving material properties and enhancing performance in pharmaceutical production. This preliminary study investigates the effects of atmospheric pressure plasma treatments in fluidized bed systems on SiO2-based pharmaceutical carrier systems, with a particular focus on their subsequent behavior during active ingredient loading and release.

As model system for these tests, silica aggregates are used as carrier systems. The specifically interesting characteristic of these particles is their defined structure and porosity which is used to enable controlled release properties. It is expected that the processability of said particles is influenced by its surface chemistry. Atmospheric pressure plasma treatments can be a valuable tool for specifically tailored chemical surface compositions. Compared to other common coating processes, this is a dry process without the need of organic solvents, which makes it environmentally friendly. At the same time only the outermost nanometers of the particles are modified, while the core material and properties remain unchanged. The influence of plasma-based coatings in this highly complex structure and its influence on further process behavior is established.

In this work, an experimental setup enabling the coating of particles is presented. Different process parameters (e.g. gas composition, coating agents, treatment time) and their influence on the dispersibility and the wetting behavior of the treated particles is tested. First results of hydrophobic coated SiO_2 particles show a decrease in wetting behavior after coating (see Figure 1). Afterwards particles with different surface coatings are loaded with APIs and their release in comparison to uncoated particles is studied. Lastly SEM measurements show the influence of the plasma-based coating on possible structural changes of the particles. These first results show the possibility to apply hydrophobic surface coatings using a Surface DBD for plasma deposition of different coating agents.

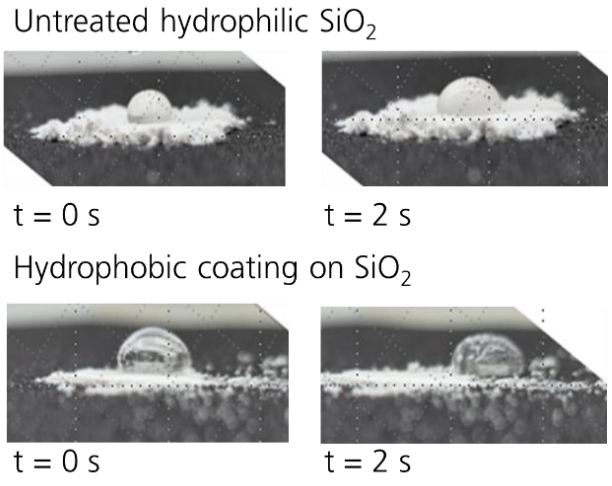

Figure 1: Wetting behaviour of SiO2 particles before (upper pictures) and after (lower pictures) plasma coating process