FUNCTIONALIZED ALGINATE MICROPARTICLES FOR FLUID FLOW VISUALIZATION

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Several methods are available for measuring the fluid movement in experimental setups. One of the most used technique is the particle image velocimetry (PIV). This is an optical technique that indirectly measures the fluid velocity by measuring the displacement of some small particles that seeds the fluid. To obtain the velocity field, the zone of interest of the experimental setup is illuminated twice with a laser beam. Two consecutive images are obtained and the displacement of the particles can be calculated. Knowing the time difference between both images allow to compute the velocity. Appropriate flow seeding is particularly critical in PIV. Particles that follow the flow accordingly and scatter enough light must be used in order to obtain accurate velocity field of the flow. Therefore, particles should be as small as possible in order to ensure good tracking of the fluid motion and they should not be too small, since they will not scatter enough light.

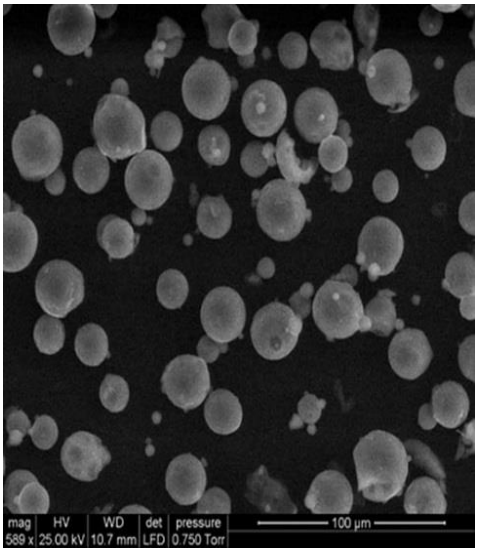

Figure 1 – ESEM images of alginate microparticles with diameter less than25 µm.

Alginate gel microparticles used in the present study have been prepared by the emulsification/internal gelation method adapted from previous reports (Wan et al., 1992, Wan et al., 1993, Wan et al., 1994, Heng et al., 2003) for encapsulation of the particles. In order to obtain smaller particles, typically d < 10 µm, a tip ultrasonicator has been used.
These spherical microparticles as flow seeding fulfil all the requirements that are recommended for the velocity measurements in PIV and offer the advantage of being environmentally friendly, having excellent seeding properties and they can be produced via a very simple process. The microparticles can be obtained from approximately 1 µm to around 100 µm in a controlled manner (Figure 1).

In the present study, the performances of alginate microparticles functionalized with a fluorescent dye, Rhodamine B (RhB), for PIV have been studied. The efficacy of fluorescence is appreciated in a number of PIV applications since it can boost the signal-to-noise ratio. Alginate microparticles functionalized with RhB have high emission efficiency, desirable match with fluid density and controlled size. The study of the particles behavior in strong acid and basic solutions and ammonia is also included. This type of particles can be used for measurements with PIV and PLIF (Planar Laser Induced Fluorescence) simultaneously, including acid-base reactions.

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