

Aerodynamically assisted jetting and threading for processing concentrated suspensions containing advanced structural functional and biological material

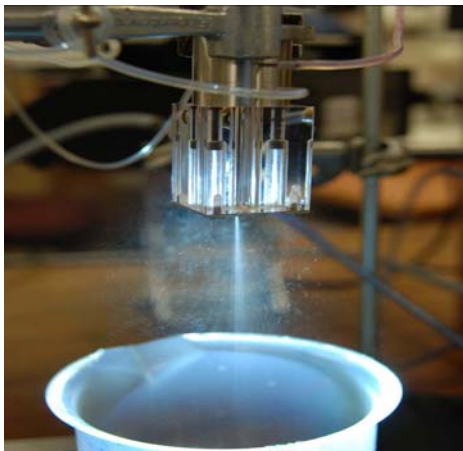


Nisco Engineering AG

Dufourstrasse 110
CH-8008 Zurich, Switzerland
Tel: +41 44 380 06 30
Fax: +41 44 380 06 31
e-mail: mailbox@nisco.ch
<http://www.nisco.ch>

Generally, there are two basic technologies in processing sciences: jet and non-jet-based. Non-jet-based technology such as lithography is highly appreciated but precludes the direct handling of living cells whereas jet-based method has a wider range of materials to deal with including living cells.

Jet-based method has some well-established approaches like Ink-jet printing (IJP) or electrospraying (ES) as well as aerodynamically assisted (AAJ) approach, which has appeared recently. AAJ approach seems to be the most appropriate to produce droplets and threads due to its versatility.



A representative image depicting the AAJ three concentric needle device operating at a random operational condition.

AAJ phenomenon

The AAJ Phenomenon takes place within a pressured chamber containing a needle (at the top end) accommodating the controlled flow of media. The exit orifice is placed centrally and in line with the needle exits. The input of a controlled pressure into the chamber gives rise to a pressure gradient across the exit orifice and generates an aerodynamic flow field. This developed flow field provides the driving mechanism for drawing out media emerging from the needle through the exit orifice.

During our experiments several jet-break-up regimes have been observed, which depend on the applied pressure, the flow rate and the media properties. With a pressure increasing the jet length is reduced and then the jet disappears. With an increase of flow rate the jet break-up length increases as well as generated droplet size.

AAJ combines in itself the best features of ES and other approaches such as switching easily from the generations of droplets to threads or from threads to scaffolds and membranes.

AAJ and living cells

AAJ has been recently applied for handling living cells. The results have revealed that the post-jetted cells had a significant population of viable cells in comparison to untreated cells. Thus, AAJ is promising approach within regenerative and therapeutic medicine.

Our current projects

We are currently developing a multi-array system with three needles, which is capable of simultaneously handling several cell types while jetting or threading with biopolymer. This is most useful for tissue regeneration and may one day be developed for directly generating biological tissues in vivo.

The picture below demonstrates the post-treated cells, which behaved comparably with controls, illustrating the suitability for forming artificial cells and organs. It means that they can be delivered to a targeted human anatomical structure and released.



controls



at 2.5 weeks post treatment

Nevertheless, the need for assessment of the cells after treatment in short and long term remains the main challenge, which involves extensive studies.

This flyer is based on the following publication:

S. Arumuganathan, N. Suter, P. Walzel and S. N. Jayasinghe, Aerodynamically assisted jetting and threading for processing concentrated suspensions containing advanced structural, functional and biological materials, *Biotechnology Journal*, 4(2009)

Issue 19.12.08