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# Enhanced Droplet Control for the Fabrication of Ceramic Breeder Pebbles

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Lithium rich advanced ceramic breeder pebbles composed of lithium orthosilicate with a strengthening phase of lithium metatitanate are intended as tritium breeders for future fusion reactors. The EU breeding blanket being designed for trial in ITER will feature the pebbles in the form of pebble beds in the wall of the reactor. Upon irradiation with neutrons, the lithium will decay into tritium and helium, after which the tritium is processed before being rerouted into the reactor core to react with deuterium and completing the fuel cycle. It is imperative that the pebbles are of sufficient quality to ensure the smooth functioning of the breeder blanket.

At the Karlsruhe Institute of Technology, a melt based process is used to produce the pebbles. A melt is formed in a platinum alloy crucible from synthesis powders at approximately 1400 ℃. Upon ejection through a 300 µm nozzle, a laminar jet is formed which breaks up into small droplets due to Plateau-Rayleigh instabilities. These describe how random instabilities grow on the surface of the jet until the surface tension overcomes the viscous forces, causing droplet break-off. However, as the break-up is considerably irregular, small changes in the droplet sizes will result in droplets with different momentum causing more to coalesce, resulting in oversized pebbles.

In order to control the break-up of the jet, and indirectly the size of the pebbles, instabilities in the form of audio waves were deliberately applied to the system. A high-speed camera was used to study the effects of varying frequencies on the behaviour of the jet. By applying the correct frequency, it was possible to increase both the yield as well as the monodispersity of the product by minimising the number of droplets coalescing, resulting in less waste and more control of the end product.

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