Table: Comparison of de-agglomeration tools, as provided from literature sources

De-agglomeration Tools	State of Nanoparticles (NPs)	Principle of Operation	Advantages	Disadvantages	Shear Energy Provided/ References
Mills (to include ball, stirred media, centrifugal and jet mills)	Mainly suitable for dry/ wet powders	Involves ultrafine grinding process	Useful for large batches	Slow/ inefficient – ball milling may take days in some cases. Grinding motion can lead to significant breakdown of nanoparticle architecture. Can be difficult to clean; contamination likely	Medium [3]
Stirring (magnetic or overhead stirring)	NPs in liquid media	The use of magnetic stir bar or an overhead-stirring paddle, having rotational speed that is sufficient to create a vortex. Overhead stirring has a much higher speed than the magnetic counterpart	Rarely results in attrition or breakage of nanoparticles Cheap/ affordable	Inefficient Rarely results in de-agglomeration and often-employed in order to improve homogeneity of dispersion. Cannot prevent particles from aggregating or agglomerating.	Low. [4].
High speed Homogeniser	*NPs in liquid media*	The use of a rotor stator generator probe; the rotor acts as a centrifugal pump to re-circulate the liquid and suspends the solids through the generator, where it will subjected to shear, impact collision and cavitations	Suitable for large liquid sample up to 2500 ml	Never tested for nanoparticle dispersion	Unknown as never tested for nanoparticle dispersion
High Pressure Homogeniser	*NPs in liquid media*	Shear and cavitations provided via increase in	Highly efficient	Nanoparticle architecture can be altered; increase of temperature	High [4].

		the velocity of pressurised liquid streams in micro-channels		in the dispersion likely. Expensive	
Ultrasound Sonicating Bath	NPs in liquid media	The use of ultrasound waves and cavitations (i.e. the formation, growth and implosion of bubbles in liquid) activity in a bath.	Cheap/ Affordable	Bath format less effective (less shear) compared to probe format. Can alter nanoparticle architecture; increase in temperature likely if dispersion is sonicated for long period. Highly variable performance at lower end of the market	Medium [4].
Ultrasound probe sonication or ultrasonic disruptor	NPs in liquid media	Similar to ultrasonic bath but aims to deliver more energy density in smaller volume in comparison to the corresponding bath format	Highly efficient	Probe tip disintegration can contaminate samples. Can alter nanoparticle architecture; temperature increase (even for a few minutes) in dispersion highly likely. Highly variable performance at lower end of the market.	High [4]

Source: us-nano.com