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XFEL MHz imaging of ultrasonic exfoliation of 2D functional materials

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Ultrasonic liquid phase exfoliation has been identified as a promising processing route for manufacturing 2D functional materials in large scale. The ultrasonic cavitation bubble implosion plays a critical role in enabling 2D layer exfoliation. However, due to the highly transient implosion process occurring at μm length and sub- μs time scale, many fundamental issues in this process are either not fully understood or not fully quantified. It is due to mainly the difficulty in directly observing the dynamic phenomena in-situ and in real time operando conditions.

Here, we report our very recent experimental results of using the MHz imaging capability available at the EU X-ray free electron laser facility. The unique world leading capability allows us to observe directly the interactions of liquid, bubble and solid phases never been reported before, providing essential data for understanding the sub- μs scale microfluidic dynamics and how the shock wave at bubble implosion is able to exfoliate the bulk graphite into multiple layer 2D sheet materials.

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