CMCC Mechanochemistry Discussions

Online Seminar Series

Direct Observations of Media Impacts During Mechanochemical Processes

Livestreaming at 10:00 AM (CT)

THURS., April 18, 2024

on the CMCC YouTube Channel:
https://www.youtube.com/channel/UC7eCYPKbGTKpgO7W2bNABxg

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https://sciences.ucf.edu/physics/blair-research/

Mechanochemical methods enable efficient and sustainable syntheses. However, their use is often criticized or dismissed due to lack of fundamental knowledge regarding the process. Study of mechanochemical processes is severely limited by the mechanical requirements of the apparatus. Opaque reaction vessels and rapid motion of these vessels are the most significant hurdles. These limitations were partially overcome by Friščić *et al.* when his team first reported *in situ* X-ray diffraction analysis during the mechanochemical synthesis of the metal organic framework compound ZIF-8. However, the study of chemical transformations at the moment of impact has been limited. We have implemented a piezoelectric impact sensor to study the impacts directly at the moderate sampling speeds of 200 kHz. Significant engineering difficulties were overcome to recover reproducible and meaningful data from impacts generated in a mixer mill. We have successfully measured the duration and force profile of the media impacts directly. This data indicated that traditional discrete element modeling (DEM) approaches do not fully capture the behavior of media in a reactor. Through comparison of impact frequency, force, and duration we are seeking to understand the effect of solid and liquid additives as well as the amount of media. Our approach is enabling a better understanding of the mechanism of energy transfer in mechanochemical processes. This fundamental approach will allow mechanochemical processes to be scaled effectively across milling platforms as well as enhance the accuracy of computational models.

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