MAE Seminar SERIES

THURSDAY,
APRIL 25

3:30 PM

114 HOCHSTETTER

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ALUMINUM PARTICLES AS NOVEL ENERGETICS

ABSTRACT

Micrometer and nanometer-sized aluminum (Al) particles have the potential for energetic applications due to their high theoretical chemical energy. However, maximizing the active aluminum content with quick energy release via effective mitigation of the parasitic amorphous and inactive alumina (Al2O3) shell is challenging. This seminar will provide an overview of two recent efforts on passivating Al particles for enhanced reactivity using different approaches. A collaborative investigation of micron-size aluminum (μAl) /graphene oxide (GO) composites will be presented first. By coating μAl powders with the light-weight oxidizer GO , our collaborators demonstrated enhanced combustion effects from optical flash lamp heating. Subsequent investigation at ARL demonstrated that the GO also increased the reactivity of μAl on the microsecond timescale, a regime relevant for detonation events. A second collaborative research project with a focus on passivating the outermost shell of nano-aluminum (nAl) particles with a specific oxidizing agent, aluminum iodate hexahydrate (AIH), using commercial nAl powders of 80 nm average diameter will also be discussed. By immersing untreated nAl in an iodic acid solution (HIO_3) to replace the amorphous alumina shell with an AIH coating, our collaborators showed significant improvement in flame speed with the nAl-AIH composite. At ARL, experiments were performed to treat nAl powders with argon (Ar) and helium (He) plasmas in different dielectric barrier discharge (DBD) reactors prior to coating the nAl with AIH. Preliminary results indicate reduced oxide shell thickness by more than 40% (from the original 4-5 nm thickness to ˜2.7 nm in average) after 10-min plasma treatments regardless of the inert gas type. The oxide shell can be further reduced to only 1 nm after subsequent AIH coating. The resultant AIH-containing plasma-treated nAl particles exhibit significantly enhanced reactivity over the untreated nAl-AIH composites in both the millisecond and microsecond timescales.

BIO SKETCH

Dr. Chi-Chin Wu is a Material Engineer at the US Army Research Laboratory (ARL). At ARL, Dr. Wu leads the plasma research for the Energetic Materials Science Branch in the Lethality Division of the Weapons and Materials Research Directorate. Dr. Wu has dual Ph.D. degrees in Material Science and Engineering from University of Virginia and in Chemical Engineering from Kansas State University. Dr. Wu's career is decorated with diverse experiences in both industry and academia prior to joining ARL in 2010. Her careers in Taiwan included industrial process safety & environmental consultancy at CTCI Co., laboratory teaching at Feng-Chia University, and a postdoctoral fellowship at Academia Sinica. In the US and before ARL, Dr. Wu was a teaching assistant, an advanced microscopy trainer, and a research scientist at UVa. She also taught at Virginia Military Institute as an assistant professor. Outside of her research work, Dr. Wu actively supports various Army Outreach Programs by being a speaker, a judge, and a mentor. Dr. Wu is also active in the materials research community. As to date, she has organized symposia three times for the MRS fall meetings (2014, 2017, and 2018).

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