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Bridging Combustion and Nanotechnology

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ABSTRACT:

Intersection between combustion and nanotechnology offers exciting opportunities to provide mutual benefits for both areas. Previous combustion research related to nanotechnology has primarily focused on the synthesis of nanoparticles (NPs), combustion of Al NPs and soot formation. Nevertheless, nanotechnology, in the past decade, has achieved significant progress in the area of one-dimensional (1-D) nanomaterials, such as nanowires (NWs) and nanotubes (NTs), and the high aspect ratios of these 1-D nanomaterials offer additional benefits of isotropic properties in comparison to NPs. 1-D nanomaterials have already made great impact on many areas, ranging from energy conversion systems, electronic and optical devices, to biological sensing and health monitoring systems, but, to a much less degree, on combustion. This talk will present two examples of our efforts in bridging combustion and 1-D nanomaterials. First, we developed several flame synthesis methods to synthesize, decorate or dope 1-D metal oxide nanomaterials and these materials exhibit much enhanced photoelectrochemical water splitting performance. Second, we applied 1-D transition metal oxides to catalyze the oxidation reactions of hydrocarbons. These 1-D nanostructured catalysts compared to the supported NPs, exhibit comparable or even better catalytic activity and stability, great flexibility in increasing the catalyst loading, and convenience in tuning the surface chemistry. Finally, we demonstrated a distributed optical ignition method that uses a camera flash to ignite Al NPs, resulting in the ignition of solid phase energetic materials, and liquid and gaseous fuels. The flash ignition occurs when the Al NPs have suitable diameters and sufficient packing density to cause a temperature rise above their ignition temperatures. Interestingly, even micron size Al particles can also be flash ignited by addition of WO_3 NPs due to enhanced light absorption and oxygen supply.

BIOGRAPHY:

Xiaolin Zheng is an Associate Professor of Mechanical Engineering at Stanford University. She received her Ph.D. in Mechanical & Aerospace Engineering from Princeton University (2006), B.S. in Thermal Engineering from Tsinghua University (2000). Prior to joining Stanford in 2007, she did her postdoctoral work in the Department of Chemistry and Chemical Biology at Harvard University. Her research interests include flame synthesis of nanomaterials and their applications in solar energy conversion, and developing manufacturing methods for flexible electronic devices. She is a member of MRS, ACS and the Combustion Institute. Her research has been honored with awards including the 3M Nontenured Faculty Award from 3M (2013), Presidential Early Career Award for Scientists and Engineers (PECASE) from the White House (2009), Young Investigator Awards from the ONR (2008) and DARPA (2008), Terman Fellowship from Stanford (2007), and Bernard Lewis Fellowship from the Combustion Institute (2004).