

Hybrid Rocket Propulsion and Related Fluid Dynamics

Content: In this session broad area of topics related to hybrid rocket propulsion and its internal fluid dynamics will be discussed. Hybrid rocket propulsion has received much attention as a propulsion system suitable for safe manned space transportation, but there are still several technical challenges in order for it to become fully operative. These technical challenges are 1) improvement of fuel regression rate, 2) better understanding of boundary-layer combustion, and 3) system optimization, etc.

Among them, the first viewpoint is directly related to improvement of fuel contents and configuration of combustion chambers and covers topics such as WAX fuel, GAP fuel, oxidizer swirling injection, CAMUI (Cascaded Multistage Impinging-jet), gas-generator-type (gas hybrid), and so on. Fuels with higher regression rate and higher energy density are sought and so is configuration with higher energy feedback to fuel and with higher combustion efficiency for a combustion chamber. It should be underlined that the first viewpoint is closely related to the second viewpoint, which covers understanding of diffusion processes of oxidizer and fuel gas species in laminar or turbulent boundary layer, heat transfer to fuel surfaces, and fuel gasification determined from the surface thermal balance. The methodology of understanding these highly-coupled nonlinear phenomena itself is also a major research target. Scaling characteristics are also important field of research. The third viewpoint is technology area for optimizing systems and/or missions dealing with hybrid rocket characteristics such as fuel generation as a function of oxidizer mass flux, missions with throttling and shutdown-restart of the engine.