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USE OF SMART MATERIAL FOR EFFICIENT AND SAFER SUB ORBITAL SPACE FLIGHTS

Abstract

Progress of science and its tools is pivotal for human existence. Ever since the first human went to space five decades ago, the space vehicles remain the same. However, companies like Virgin Galactic are now testing rocket powered sub orbital flights that could take civilians to near space and provide them an experience of lifetime whilst being used to transfer payloads and astronauts to orbits in the future. In order to achieve sub orbital space flights, the vehicles have to attain extremely high velocities where they undergo different regimes of velocities like subsonic, transonic, supersonic and sometimes even higher- hypersonic velocities. The reentry phase of the vehicle involve speeds from 25 Mach speed to very low subsonic speeds. For different regimes we have different design characteristics. In the case of subsonic vehicle, the nose and leading edges are round but in transonic regime vehicle, the wings should be swept to delay drag divergence and adhere the principles of Whitcomb; in supersonic speeds, we see large difference in aerodynamic design because of radical difference between flows above 1 Mach like sharp edges and thin airfoil sections; in hypersonic and higher hypersonic speed we see small wings and blunt configurations whereas during reentry, we prefer ablative heat shield, small or no wing and blunt shape. But in space vehicles used today, the entire shape (of the launched or re-entry vehicle) remains same throughout entire journey causing various aerodynamic instability and problems. These problems can be resolved by using smart material such shame memory alloys and piezoelectric materials. SMA are materials in which large deformation can be induced and recovered through temperature changes or stress changes and piezoelectric material respond to electrical change by changing its shape in no time. Using these properties of both the materials we can create safer aerodynamical components of the vehicle. Due to its dual property, we can also use it for sensor to sense if there is any collision or deformation (like from space debris) as well as for actuator for shape control. We can also use piezoelectric with ceramic material in order to withstand the heat. Using combination of both of the materials we can develop a sub orbital vehicle that is both economical and extremely safe for commercial usage. This paper highlight some of the experiments and its results for the same.