Effect of Dissimilar Valve Lift on a bi-fuel CNG Engine Operation

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Abstract

The combustion of spark ignition engines converted to bi-fuel CNG is unstable and proper air and fuel mixing strategy is a concern. Also, CNG fuel causes the coefficient of variation for indicated mean effective pressure (COV_{imep}) higher than 10% which is into the region of unstable combustion. In order to create stable combustion more turbulence is required. This paper studies the valve movement with dissimilar valve lift (DVL) to increase swirl in the engine. The intake valve is the last point of airflow entry into an engine and the modification of the movement can contribute to increase turbulence. Three DVL setting simulated via computational fluid dynamics (CFD) gave improvement in peak pressure by 4% and a 32.2% improvement in flame propagation speed compared to baseline CNG. Engine testing shows that, the engine COV_{imep} improves up to 8.7%, while efficiency improves by 5.7% and BSFC is reduced by 5.4% respectively with the 1 mm DVL at 4000 rpm compared to baseline CNG. The rate of heat release (ROHR) also shows early heat release of the fuel. The novelty is better mileage for future CNG engine design.

Keywords: CFD; Compressed natural gas; Spark ignition engine; Swirl number

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Humidity Versus Photo-Stability Of Metal Halide Perovskite Films In A Polymer Matrix†

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ABSTRACT

Despite the high efficiency of over 21% reported for emerging thin film perovskite solar cells, one of the key issues prior to their commercial deployment is to attain their long term stability under ambient and outdoor conditions. The instability in perovskite is widely conceived to be humidity induced due to the water solubility of its initial precursors, which leads to decomposition of the perovskite crystal structure; however, we note that humidity alone is not the major degradation factor and it is rather the photon dose in combination with humidity exposure that triggers the instability. In our experiment, which is designed to decouple the effect of humidity and light on perovskite degradation, we investigate the shelf-lifetime of CH3NH3PbI3 films in the dark and under illumination under high humidity conditions (Rel. H. 4 70%). We note minor degradation in perovskite films stored in a humid dark environment whereas upon exposure to light, the films undergo drastic degradation, primarily owing to the reactive TiO2/perovskite interface and also the surface defects of TiO2. To enhance its air-stability, we incorporate CH3NH3PbI3 perovskite in a polymer (poly-vinylpyrrolidone, PVP) matrix which retained its optical and structural characteristics in the dark for B2000 h and B800 h in room light soaking, significantly higher than a pristine perovskite film, which degraded completely in 600 h in the dark and in less than 100 h when exposed to light. We attribute the superior stability of PVP incorporated perovskite films to the improved structural stability of CH3NH3PbI3 and also to the improved TiO2/perovskite interface upon incorporating a polymer matrix. Charge injection from the polymer embedded perovskite films has also been confirmed by fabricating solar cells using them, thereby providing a promising future research pathway for stable and efficient perovskite solar cells.

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