In this study, tungsten trioxide (WO₃) nanostructure material is integrated onto interdigitated (IDE) Micro-electro-mechanical (MEMS) platform to form a gas sensor targeting to detect ethylene gas. Traditionally, ethylene gas detection requires the sample of the gas to be collected and measured offline due to the complexity of the measurement system. Even though a newer detection technology which enables for in-situ detection has been developed, the size of the sensor is relatively bulky and very expensive hence it is not suitable for mass outdoor applications examples in the agriculture industry. Therefore, this research explores a different approach to detecting ethylene gas utilizing WO₃ nanostructure as the sensing element of the sensor. This n-type metal oxide family were recognized for its excellent properties such as hardness and wear resistance. Typically, wurtzite phase WO₃ nanostructures have been produced by this facile process. Since the response of the gas sensor is highly dependent on the surface analysis, the analysis of gas response to ethylene gas was 1.23 at 20 ppm obtained from sensor fabricated by spin coat fabricated sensor. At the same ethylene concentration, the sensitivity for drop cast and spin coating process are much lower at 1.05 and 1.04 respectively. In terms of response behaviour, spin coat sensor exhibits fastest response and recovery (7 minutes and 13 minutes) as compared to spin coat process (14 minutes and 28 minutes) and in situ process (10 minutes and 16 minutes). This study contributes the knowledge of controlled hydrothermally synthesis of WO₃ and at the same time proves that the fabricated NANO/MEMS sensor platform are able to detect ethylene gas. This finding is significant in developing ultra-sensitive, small in size and requires low power consumption ethylene gas sensor, especially for precision agricultural applications.