Oxygen generation by glow discharge under simulated martian conditisons Maocheng Qian[1,2], Zhongchen Wu[1,2*], Fabao Yan[3,4]. Zhongcheng Ling[1,2], Yinyu Zhou[1,2], [1]Institute of Space Science, Shandong University, Shandong, China (z.c.wu@sdu.edu.cn); [2]Shandong Key Laboratory of Optical Astronomy and Solar-Terrestrial Environment, Institute of Space Sciences, Shandong University, Shandong,264209,China;[3]School of Mechanical, Electrical&Information Engineering, Shandong University;[4]Laboratory for ElectromAgnetic Detection, Institute of Space Sciences, Shandong University, Shandong, China

Introduction: The thin CO_2 atmosphere and strong oxidizing environment of Mars make it harsh and inhospitable for human survival. In-situ resource utilization to product the supplies of life-sustaining materials such as O_2, H_2O and energy is the key technology for Human migration. Under low pressure about 600pa, the Martian atmosphere is nearly ideal for glow discharge which can generate O_2 and CO by decomposing CO_2 gas. Comparing to other methods of O_2 generation, CO_2 glow discharge under Mas conditions has several benefits such as lower-energy, lower-weight, higher-performance and easy to manufacture. In this study, several key parameters of CO_2 glow discharge related to the final yield of O_2 and CO [1,2]were invested.

Experiment: The purposes of our experiment were to detect the key CO_2 plasma reaction products (i.e., CO_2, O_2, O_3) and calculate their reaction yields under Martian simulated conditions with various working parameters. The experiment was conducted in the Mars environmental simulation chamber (cylinder-shaped,diameter 15cm ,height 40cm） which can hold an atmospheric components and pressure similar to that on the Mars surface. The experiment set-up was shown in **Fig.1**. Two self-made parallel rounded copper planes (diameter 20mm; thickness 10mm) were used as discharge electrodes with a gap of 2mm to 5mm. The CO_2 gas plasma can be generated between the two parallel electrodes when a certain high A.C. voltages were applied to the tow electrodes. In order to achieve those aims, three electrochemistry gas sensors were purchased to continuously in-situ detect the concentration of CO(Guangzhou Xinnuo lntelligent Equipment Co.,Ltd.,MIC-500S-CO), O_2(Guangzhou Xinnuo lntelligent Equipment Co.,Ltd.,MIC-600-O2) and O_3 (Shenzhen Korno Import & Export Co.,Ltd., WT-80-O3) by sampling end gas at fixed flow rate during CO_2 plasma reaction.

Result: As show in **Fig.2.** the concentration of O_2 and CO increased quickly at the beginning of CO_2 plasma generation, and then became stable because the dynamic balance of new generated O_2 and CO in the Mars chamber were achieved. Finally, the concentration of O_2 and CO reduced to zero after turning off the power supply of CO_2 plasma.

The value of stable concentration of O_2 and CO in **Fig.2** means the stable yield of O_2 and CO which was used to calculate the final yield of reaction produces under various parameters. After parameter optimization (such as excitation power of CO_2 plasma, discharge voltage, discharge gap distant, gas pressure et al.), the biggest yield is 1.33g/hr for O_2 with plasma exciting power of 182.7W.

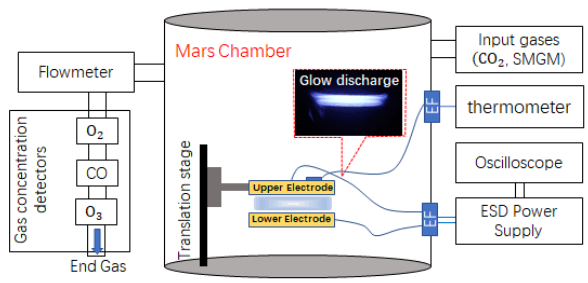

Fig.1 The setup of O_2 generation in a Martian chamber

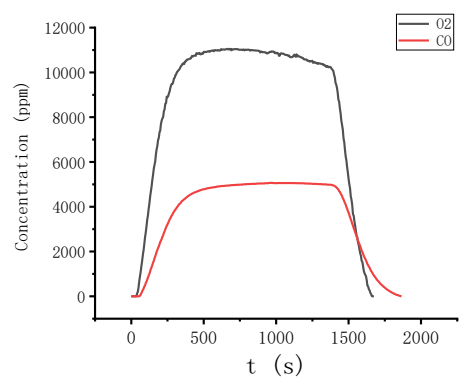

Fig 2 The variation of O_2 and CO concentration in end gas during CO2 discharging

Conclusion: In this study, an experimental setup for O_2 generation were built using a Mars chamber and the main plasma reaction products of CO_2 gas, i.e. O_2 and CO were detected and optimized. Our results verify the feasibility of generating O2 on the surface of Mars. And more results will be published soon.

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References:

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