Measurements of Temperature of the Tungsten Hexa-Ethoxide Pyrolysis Flame using IR Camera

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Abstract: In laser pyrolysis, temperature measurement and control plays a vital role during the development of nanoparticles. We present the results of temperature measurements using infrared camera on a tungsten hexa-ethoxide pyrolysis flame used to synthesize nanoparticles from laser pyrolysis technique.

1. Introduction

The ever increasing interest in nanoparticles and their applications have led scientist and engineers to explore and develop different of techniques to synthesize them. One of the techniques investigated extensively [1] for the industrial production of nanoparticles is the laser pyrolysis technique. In this technique, the temperature of the pyrolysis flame in the reaction zone can be altered as a result of the change in laser power [2]. When the temperature of the flame in the reaction zone changed, nanoparticles with different structures can be developed [2]. To determine the temperature of the pyrolysis flame inside the reaction chamber a contact and non-contact technique can be employed. In this experiment, the temperature of the flame was measured by a non-contact, nonintrusive infrared (IR) thermography technique using a very long wave infrared (VLWIR) camera. This technique can also be employed in areas that are inaccessible due to hostile environments, geometry limitations, and safety hazards [3].

2. Experimental setup

Figure 1 show the experimental setup used. The reaction chamber shown was described in details elsewhere [4]. The zinc selenide (ZnSe) window in one arm was removed, and the VLWIR camera calibrated prior the measurements was setup as shown in figure 1, looking through an arm without the ZnSe window perpendicular to the CO_2 laser beam. The laser power was varied from 10 W to 60 W. The precursor used is tungsten hexa-ethoxide.

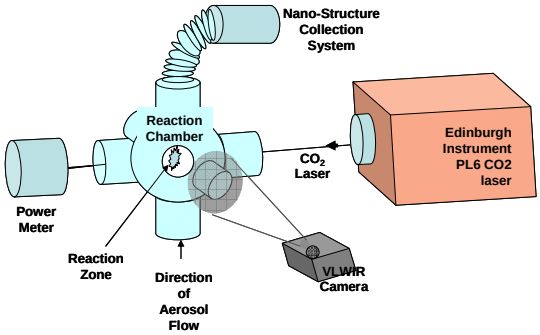

Fig. 1: A schematic representation of the experimental setup used to measure the temperature of the flame

Laser Power (W)	Min Temperature (K)	Max Temperature (K)	Average Temperature (K)	Standard Deviation
10.00	687.00	688.87	687.85	02.86
20.00	694.38	697.36	695.52	01.70
30.00	710.78	722.77	713.93	03.43
40.00	730.49	745.55	737.38	14.48
50.00	753.77	773.84	764.99	15.62
60.00	756.21	798.23	770.35	09.25

Table 1 Summary of the temperature measured in the reaction zone.

3. Results

Table 1 shows the minimum, maximum and average temperature calculated at different laser powers with the standard deviation. The result shows that when the laser power is increased, the temperatures also increase.

4. References

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