Condensational enlargement of carbon agglomerates

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Abstract

The condensational enlargement of soot agglomerates with organic materials was investigated. Soot-like agglomerates in the size range of 30-120nm were generated by spark discharging which is controlled by some variables such as carbon electrode distance, spark repetition frequency and carrier gas flow rate. The result shows that condensation of organic materials on the ultrafine carbon agglomerates can bring them to a submicron and more size range.

Keywords : spark discharge, ultrafine carbon agglomerates, condensation, enlargement

1. INTRODUCTION

There is many experimental evidence that unltrafine particles below 100nm and organic materials in diesel exhaust are associated with harmful effects on human health. To reduce the noxious components in diesel exhaust, the aftertreatment devices such as diesel particulate trap was developed and the filter in it can effectively remove particles. However, gaseous organic materials, mainly generated from unburned fuel and lubricant oil still remain after the treatment and causes new particle generation by nucleation and condensation in exhaust pipe. Therefore, before diesel exhaust enters the trapping system , condensing the organic materials on diesel particulate matter is expected to reduce the gaseous organic components, and moreover, it will improve the trapping efficiency of the filter by increasing the size of diesel particulate matters.

2. EXPERIMENT

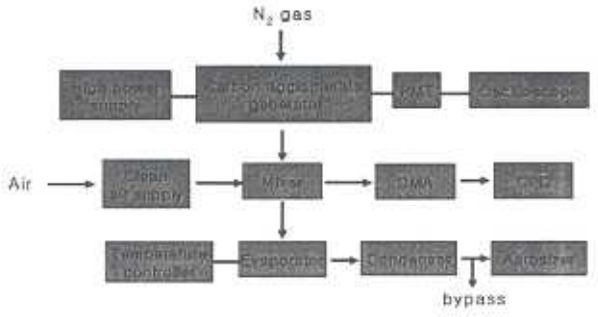
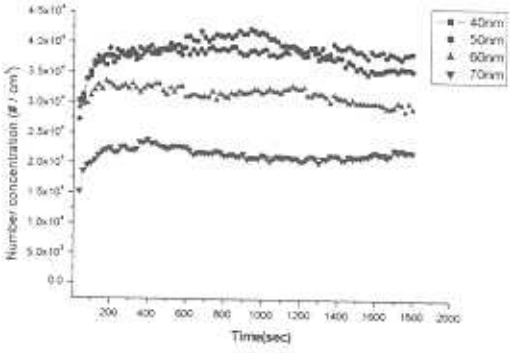


Fig 1. Experimental schematic diagram

Fig 1. shows the experimental schematic diagram. The effect of variables on size distribution of the soot-like agglomerates was evaluated. SMPS (DMA 3071, CPC 3022A) measured the size distribution of the agglomerates which just came out from the spark generator. To suppress further coagulation and

reduce the concentration of particles the mixing chamber was introduced. The aerosol including carbon agglomerate guided into the electrical evaporator and condenser where the condensational enlargement of carbon agglomerates happened. Then, Aerosizer (DSP, Model 3220) measured the size distribution of the enlarged agglomerates. Water and benzene were used as condensational materials.

3. RESULTS



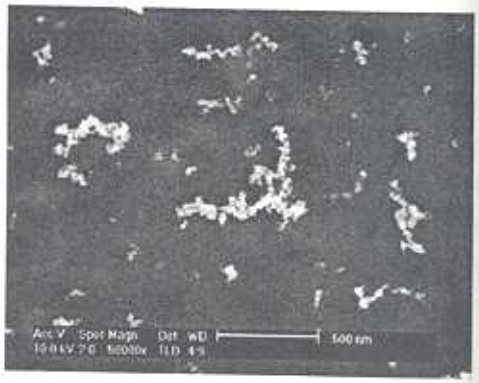


Fig2. Result of constant generation and SEM image of the carbon agglomerates

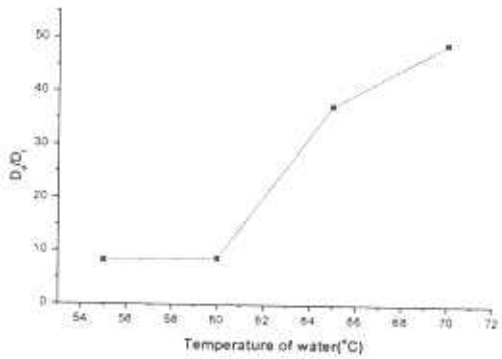


Fig3. ratio of mean size after/before condensation by water

As shown in Fig2, soot-like carbon agglomerates were constantly generated by the spark discharge generator and the agglomerates was in the size range from 30 to 130nm controled by variables of the generators such as carbon electrode distance and spark repetition frequency. Fig3 shows the result of condensational enlargement of the agglomerates by water. The initial mean size before entering evaporator was 36nm constantly, and the largest enlarged mean size was 2.27μm at 70℃ of water in evaporator. The cooling temperature was 15.4℃ during the condensation

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