Single dust particle analysis to trace the origin

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Fine dusts in the atmosphere can lead to harmful effects on human health because its toxicity is largely unknown. Understanding the mineralogical and chemical forms of atmospheric particulate matter is crucial because inhaling these particles can increase in mortality and morbidity due to cardiovascular and pulmonary disease [1]. The quality of the urban atmospheric environment is of growing concern as particulate matter contains the toxic chemical composition, in particular the transition metals within the particle [2] Chromium is one of the interesting transition metal due to its in two valence states: Cr(VI) is much higher toxic compared with Cr(III) [3]. Therefore, chemical species analyses of Cr-bearing particles are one of the most critical criteria to be considered. In order to identify the chemical forms of single dust particles, it is essential to understand the microstructures and chemical composition of Cr-bearing particles using TEM.

The dry deposition of fine dust were sampled from 31 March 2007 to 14 November 2008 in northwestern Daejeon (36°20'N and 127°22'E). In order to select isolated Cr-containing particles among the dust powders for TEM analysis, identification based on the particulate morphology and the chemical composition was carried out in a dual-beam FIB (Helios NanoLab 600) equipped with EDS. For the investigation of individual nano-sized transition metal particles embedded in the Cr-containing aggregates, SAED patterns and EDS elemental maps were acquired using TEM (Talos F200X) equipped with Super-X EDS system.

STEM-EDS analysis and SAED patterns clearly identify that spherical black carbon has internally nano-sized particulates, which were characterized as monoclinic lead chromate ($PbCrO_4$) (see included figure) and zinc chromate ($ZnCrO_4$) which were atmospheric Pb, Zn and Cr(VI) pollution source in the fine dusts. Cr(III) was also found in spinel-type geochemical forms such as $(Fe,Cr)_3O_4$ magnetite, derived from coal combustion and metallurgical industrial emissions [4]. This study shows that microstructure analysis of single dust particle using TEM can help us to find the origin of the microdust.

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