Multi-scale Analysis on Speciation of Toxic Metals in Urban Dust (SRM 1649a) and Indoor Dust (SRM 2584)

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The systematic multi-scale (nano to bulk) analytical techniques were successfully applied to investigate the speciation of Pb, Mn and Cr in NIST standard reference materials of Urban Dust (SRM1649a) and Indoor Dust (SRM2584). The major phases of bulk particles were determined by X-ray diffraction pattern (XRD) combined with elemental maps using scanning electron microscopy (SEM). The configuration and composition of micro-scale and nano-scale heavy metals particles such as Fe, Th, Ti and Pb were detected by SEM-EDS technique and transmission electron microscopy (TEM) respectively. Comparison of the data from urban dust and indoor dust suggested that the source of fine particles were different. Many nano-scale Pb-particles and some spherical Fe-particles detected in urban dust suggested they would come from combustion of oil or coal compared with rarely large Pb-particles in indoor dust could be from interior decoration materials. The speciation of Pb, Mn and Cr were determined by X-ray absorption near-edge structure (XANES) spectra. Based on the XANES data, $PbSO_4$, $MnSO_4$ and chromite ($FeCr_2O_4$) were contained in the urban dust comparing with PbS, $MnCO_3$ and mixture of Cr_2O_3, chromite, Mn-chromite included in indoor dust respectively. Because of the toxic speciation of heavy metals and also most of the toxic heavy metals associated with fine fraction at nanometer scale in both SRMs, these toxic metals can penetrate into the deeper part of the respiration system and have bad effects on human health. In addition, the nanometer-sized phases (˜10 nm) of toxic metals may have different thermodynamic property from that in bulk, which leads to significant under estimation of their bioavailability.