In situ gas-phase synthesis of atomic tungsten, molybdenum and chromium oxide, and palladium carbonyl clusters at atmospheric pressure

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Gas-phase synthesis of molecular clusters and nanoparticles is a topic of interest for various applications. Current research on atomic metal clusters takes place often in vacuum conditions, hindering their potential industrial scale applicability. We present an in situ method to synthesize atomic metal clusters in gas-phase and atmospheric pressure by heating of metal wires. The hot wire generator[1] was utilized to generate atomic clusters of tungsten, molybdenum (Figure 1), chromium and palladium clusters. Mass analysis of the clusters showed the clusters to be tungsten, molybdenum and chromium oxide clusters, and palladium carbonyl clusters free of contaminants. The electrical mobility analysis revealed that the formed tungsten and molybdenum oxide clusters are identical in their structure while chromium oxide clusters exhibit higher electrical mobility compared to the other two, indicating smaller physical size when chromium is the core atom in the cluster. Our results show a method to produce atomic metal clusters directly to gas phase in atmospheric pressure. This enables research on metal clusters properties at atmospheric pressure, which is essential for their large scale applicability.

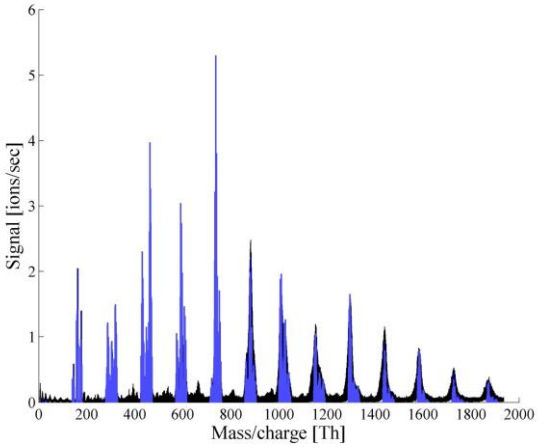

Figure 1: Mass spectrum of the synthesized negatively charged molybdenum clusters. Peak groups are separated by Mo3, peaks within one group are the same oligomer charged with either by an electron, OH^- or O_2^-.

1. Peineke, C.; Attoui, M. B.; Schmidt-Ott, A., Using a Glowing Wire Generator for Production of Charged, Uniformly Sized Nanoparticles at High Concentrations. *J Aerosol Sci* **2006**, *37*, 1651-1661.