Knudsen Cell measurements applied for the study of gaseous precursors and chemical process acting in aerosol formation for the RADES (RAdiological Dispersion Events Set-up) set-up.

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Characterization of the aerosols formed during accidents and sabotages involving nuclear and radioactive material, is of main importance for the radiological risk assessment. The quantification and characterization of the source term (which includes the aerosols, but also the gaseous species released) is in fact the input for calculation of the extension and level of contamination, following events in which radioactivity is released in the environment. Furthermore the chemical composition of the release is essential to calculate the health risk for the population concerned (radiotoxicity). As reported by Molecke "These data are the input for follow-on modeling studies to quantify respirable hazards, associated radiological risk assessments, vulnerability assessments, and potential cask physical protection design modifications." (Molecke *et al*. (2006)).

A novel experimental set up RADES (as described in detail by Di Lemma et al. (2012)) has been developed for the study of the aerosol released from RDE's (Radiological Dispersion Events); in this poster the aerosol characterization of particles produced during RDE's involving nuclear fuel will be presented. Tests were conducted on simulated nuclear fuel, consisting of non-radioactive samples: they were composed of a ZrO_2 matrix simulating UO_2, doped with chemicals which simulate fission products. The RADES set-up permits to create aerosol in controlled condition (gaseous atmosphere and pressure), to collect them and to perform then post-analyses on these (such as chemical and elemental composition, as well as size distribution). In order to better understand the chemical processes occurring in the RADES set-up, which influence the final composition of the aerosols and so their radiotoxicity, the measurements have been linked with a Knudsen Effusion Mass Spectrometer (KEMS) measurement. By the KEMS in fact we are able to measure and analyse the behaviour of the partial vapour pressure over the simulated fuel in equilibrium conditions and in function of the temperature. From these data we could infer the composition of the vapour created from the simulated fuel, which can represent further the vapour precursor of the aerosols. These data are then confronted with the data from ICP-MS, RAMAN and SEM-EDX analyses performed on the aerosol created and collected in the RADES set-up, which give information on the elements present in the final formed aerosol and their chemical composition. These studies may permit to understand the chemical reaction of the initial vapour with the environment in the RADES set-up, though it must be realised that the operating conditions of the two instrumentations are very different. In the RADES set-up the sample is heated to very high temperature (up to 4500 K) with very fast transients (tenths of ms) in atmospheric condition, while the KEMS operates "in vacuum", in equilibrium conditions. This will may permit on the other hand to analyse the different vaporization processes occurring in different conditions, and permit to understand how the vaporization/condensation processes in the RADES relate to the aerosol formation in non-equilibrium conditions.

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Molecke, M.A, Brockmann, J.E., Lucero D.A. et al. (2006) 47th Annual Meeting of the INNM.