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Molybdenum nanoparticles as target for the production of molbydenum-99

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The main objective is to develop a new production route for high specific activity molybdenum-99 based on the irradiation of molybdenum nanoparticles. In order to achieve this, molybdenum nanoparticles have been produced by spark ablation.
The spark ablation technology provides an easy method to produce nanoparticles with controlled size. It consists of a gas phase physical process in which nanoparticles are produced by inducing spark discharges between electrodes, made of molybdenum in our case.
Once produced, the nanoparticles will be irradiated by the accelerators in the JRC facilities in Geel and in the nuclear reactor HOR in TU Delft with high-energy photons or neutrons. The produced ⁹⁹Mo will experience a recoil effect that will expel the radionuclide out of the nanoparticle. By this atom displacement, the produced ⁹⁹Mo may be separated from the other isotopes of molybdenum that constitute the nanoparticles, leading to a high specific activity product.
After the irradiation, the targets will be eluted to separate the produced 99Mo from the nanoparticles. Depending on the type of target, different separation methods will be applied, including specific extracting agents, filtration and centrifugation. The eluate will be analysed by gamma spectroscopy and elemental analysis characterization techniques to determine the extraction yield and the specific activity.
In a first step, molybdenum nanoparticles have been successfully generated by spark ablation using natural molybdenum electrodes and argon as carrier gas. We observed that the particle size mainly depended on the inert gas flow. As it can be seen in figure 1, at a argon flow of 1 L/min big agglomerates of more than 200 nm, meanwhile at 2 L/min the size of the agglomerates is decreased by a half. At 5 L/min the agglomerates, of smaller size, are mixed with small particles. When the gas flow is increased to 10 L/min now agglomerates are visible and only particles are produced.

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