# Recent advances in the radiolabelling of nanoparticles using cyclotron-based techniques

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The use of radiolabelled nanoparticles can be a powerful tool in the field of nanotoxicology for highly sensitive detection, tracing and quantification of nanoparticles either *in vitro* or after their incorporation or administration into plant or animal models. Such studies can be used to evaluate nanoparticle biokinetics, including nanoparticle passage across biological barriers and possible long term accumulation.

In this context, the European Commission's Joint Research Centre (JRC) has been developing a range of methods at its Cyclotron facility for the labelling of nanoparticles with gamma emitting radionuclides with long enough half-lives for tracing studies over several weeks or months.[1]

We present here an overview of these techniques, together with the most recent results achieved in our laboratories. Techniques include the direct exposure of nanoparticles to light ion beams, recoil labelling of nanoparticles with radionuclides from an extrinsic source material, and nanoparticle synthesis using radioactive precursors. With regard to the latter, particular examples will be provided for the case of 105g-Ag labelled silver and 195-Au labelled gold nanoparticles, also discussing the main concerns regarding their chemical stability and colloidal performance in the tested environments.[2]

[1] Gibson N, Holzwarth U, Abbas K, Simonelli F, Kozempel J, Cydzik I, Cotogno G, Bulgheroni A, Gilliland D, Franchini F, Marmorato P, Stamm H, Kreyling W, Wenk A, Semmler-Behnke M, Buono S, Maciocco L, Burgio N (2011) Radiolabelling of engineered nanoparticles for in vitro and in vivo tracing applications using cyclotron accelerators. *Arch Toxicol* 85:751–773.

[2] Ichedef C, Simonelli F, Holzwarth U, Piella Bagaria J, Puntes V F, Cotogno G, Gilliland D, Gibson N (2013) Radiochemical synthesis of 105gAg-labelled silver nanoparticles. *J Nanopart Res* 15:2073.