

## Radiolabelling of Nanoparticles using Cyclotron-Based Techniques

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Radiolabelled nanoparticles can be used for tracing studies of relevance to many fields, such as nanomedicine, nanotoxicology, environmental tracing, occupational health, etc. Various methods for nanoparticle radiolabelling exist, each with advantages and disadvantages for particular studies. An outline is presented here of cyclotron-based techniques that can be used to directly radiolabel engineered nanoparticles, as well as some methods for synthesis of labelled nanoparticles using cyclotron-generated radioactive precursor materials. A basic outline is given of how cyclotron accelerators can be used to induce nuclear reactions, the characteristics of different radio-isotopes and their practical applicability for tracing, and what effect the direct ion-beam radiolabelling process might have on the nanoparticles themselves. In particular, the issues of thermal effects and radiation damage effects are addressed.

Selected details are presented regarding some of techniques applied in our laboratories and those of collaborating groups, including direct light-ion activation of dry nanoparticle samples, neutron activation using a cyclotron ion-beam driven source, preparation of activated precursors and physical nanoparticle synthesis methods, recoil-labelling via ion bombardment of mixed powders, and radiochemical synthesis of nanoparticles using radioactive precursors.

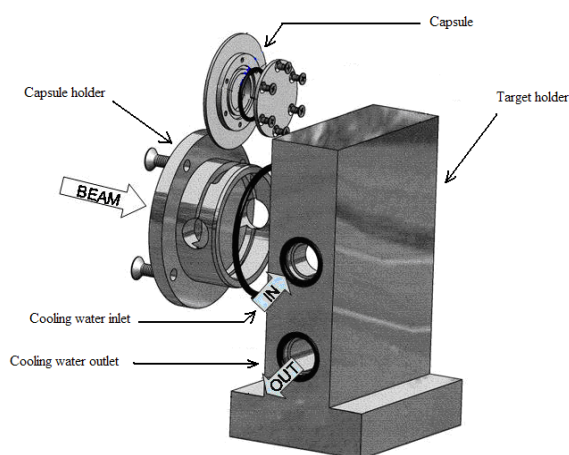


Figure 1: The Scanditronix MC-40 Cyclotron at JRC Ispra, and the target capsule and holder used for direct ion-beam radiolabelling of dry nano-particulate powders.