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Encapsulation methods for solid radionuclide production targets at a medium-energy cyclotron facility

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The majority of batch targets for the cyclotron production of radionuclides at iThemba LABS typically have circular disc or flat cylindrical shapes, with the beam normal to the circular surfaces and usually swept (or wobbled) to reduce the beam power density. These targets are completely surrounded by fast-flowing cooling water during bombardment. Target materials that need protection from the cooling water (e.g. soluble substances such as compressed salts and/or alkali metals that rapidly react with water) are encapsulated (or clad) with a substantially inert metal that has a relatively high melting point. For this purpose, aluminium, niobium and stainless steel (grade 316) are mostly employed. While the cold target materials are normally in a solid state (i.e. when out of the beam), they are likely to become partially, or even completely, molten under bombardment conditions. The target capsule serves as a barrier to the cooling water as well as to contain the target material and to maintain its shape, should melting occur.

The main aim of this presentation is to discuss the various methods of target encapsulation employed at iThemba LABS, based on cold indentation welding, electron beam (EB) welding and laser welding. While the latter two methods are more modern and "state of the art", it will be argued that the "largely forgotten" method of cold indentation welding is still decidedly useful, uncomplicated, reliable and inexpensive. It is therefore still routinely utilized for some production targets as well as experimental targets at iThemba LABS. A brief discussion on the target holders, tandem targetry and the two target stations for high-intensity bombardments with 66 MeV proton beams will also be presented. It will be shown how the use of a beam splitter in conjunction with tandem targetry in both target stations, enables the laboratory to bombard four encapsulated targets simultaneously.

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